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Hydraulic Mining in California.*

CONTINUED FROM PAGE 223.

Under-currents.—These are large flat boxes, or platforms, placed beside and a little below the main sluice-boxes. Their size and shape depend, to some extent, on the facilities which the place offers where they shall be constructed. Triangles, irregular oblongs, and parallelograms, containing a surface of from 500 to 1000 square feet, are the forms often resorted to. The under-current is destined to receive from the main sluice-boxes a certain portion of the finer gravel-wash, black sand, quicksilver, and amalgam, and to afford to the particles of gold and amalgam a better chance to settle permanently in the riffles, which are evenly distributed over the whole surface of the platform. For this purpose an opening is cut across the bottom of the main sluice-boxes from 15 to 18 inches in width. In this opening are inserted steel bars, 1 inch sq are and 1 inch apart, generally fixed in a cast-iron frame. The small particles of gravel, sand, gold, etc., which pass through this grating are caught in a box placed below the sluice-boxes, on a pitch of about 1 inch per foot, whence they are carried upon the large platform provided with riffles.

This platform is placed on a grade of from 10 to 12 inches per 12 feet, and is provided with an opening at the lower end to return the bulk of the material received to the main sluice-boxes below.

To distribute evenly the water and gravel received from the main sluices, a number of check-boards are placed at the upper part of the platform, in a direct line with the box under the grating of the main sluice, which receives the discharged matter. As the water, etc., rushes out of this box, part of it strikes against the nearest check-board and is turned down the platform; the remainder, rushing on, is diminished by each succeeding check-board, and an even distribution over the whole platform is gained. At the lower end of the platform the discharge of the water, etc., into the main sluice below may be arrested by the insertion of a small box, on a grade, into which the material drops from the riffles. These riffles can be made either of 2 by 3 inch scantlings, laid down lengthways and 2 inches apart, or of common blocks or stone pavement.

The under-current and main sluice-boxes discharge their contents into a deep and strongly-built box, provided with a heavy stone pavement. From the upper part of this box a continuation of the main flume leads the gravel-stream to other under-currents, drops, etc., and to a final discharge. The lower part of this box must be 4 or 5 feet deeper than the point from which the main-sluices are continued—and will be found of great service in catching amalgam, etc.

The gratings in the main-sluices deprive the latter of a quantity of water. To counteract this loss the main-sluices are narrowed about 6 inches to condense the current of water till both streams, that of the under-current and that of the main sluice-boxes, re-unite as described above.

When there is sufficient room, under-currents may be placed on each side of the main sluice. This plan is recommended in all localities where great care has to be taken in the distribution of a limited grade. An under-current of 50 feet length will absorb about 8 feet of grade, and for this reason the plan of establishing two under-currents opposite each other is highly economical, when practicable.

These under-currents are of the greatest service in catching rusty gold, which cannot be touched by quicksilver, and which, lessened in specific gravity by the foreign matter clinging to it, is very liable to be carried entirely through a long line of sluices to the final discharge. The gentler and shallower place on the platform of the under-current gives to this rusty gold more chances to be caught by the extensive riffles.

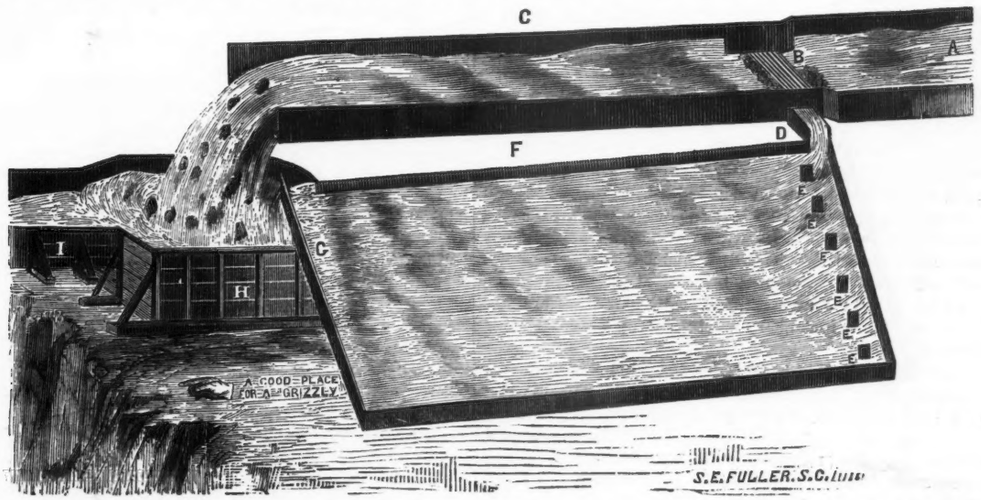

Fig. 16.—Sluice and under current. A, main sluice or flume; B, grating of steel bars; C, main sluice narrowed; D, box under grating; E E, check-boards; F, platform of undercurrent, (perspective distorted to show details); G, box leading into drop; H, drop-box; I, continuation of sluice. The undercurrent is 50 feet long and 20 feet wide; grade, 1 inch per foot.

The Grizzly.—This word, in the strange nomenclature of the California miner, means a grate or frame-work of parallel iron bars, with interstices, which is used here and there in the line of sluice-boxes to throw large pebbles or stones out, and to permit such particles only as can pass easily through the interstices between the iron bars to be carried further along in the sluice-boxes. Wherever a grizzly is applied, a drop of a few feet is necessary; since the material which can pass through must be collected in a box below and thence carried away by a lower section of sluice-boxes. The construction of grizzlies is of use only where the stones to be discharged over the grizzly can be thrown down a steep embankment. When this is the case, the sluice-boxes can thus be relieved of a great quantity of useless material.

To illustrate, we will suppose that a precipice of 40 or 50 feet exists close to drop-box H, represented in the accompanying sketch, so that any material thrown outside of this box would tumble down the precipice. This would give a favorable chance to apply a grizzly, which would have to be done by attaching a frame-work of strong iron bars (condemned iron rails are excellent) to the bottom of the sluice-box which discharges its contents into drop-box H, and to lead this grate, with a fall of about 30 degrees, across the drop-box H and towards the precipice.

The iron bars or rails would have to run the full width of the sluice-box, 6 inches apart and parallel with each other, towards the precipice, and all bowlders larger than 6 inches in diameter would be discharged. On both sides of this grating planks must be fixed to prevent any of the stones from escaping sideways.

* By Mr. CHARLES WALDEYER, of Cherokee, Butte County, California, in Prof. RAYMOND'S Report on the Mineral Resources West of the Rocky Mountains, 1873.

Hydraulic nozzles.—The observant miner early perceived that if a certain amount of gravel could be washed with a certain quantity of water, double the quantity of water would wash from three to four times as much gravel without increasing the expense for labor in proportion. Greater quantities of water and enlarged hydraulic nozzles were therefore introduced, and the latter became very soon the objects of inventive speculation, which resulted in the successful production of very ingenious hydraulic machines.

The first improvement was a flexible iron joint, formed of two elbows working one over the other, with a coupling joint between them. These elbows were called goose-necks.

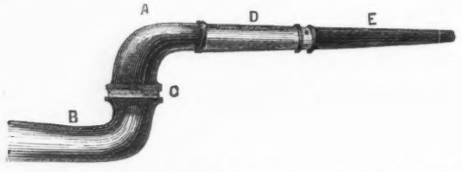

Fig. 17.—Goose-neck. A B, elbow ; C, joint ; D, piece of hose ; E, discharge-pipe.

This invention was a decided improvement, though it showed some serious defects. The abrupt turn of the elbow broke the force of the water to a great extent ; the upward pressure made the joint c hard to move, and when the pipe was turned horizontally the hose part would often bend a little too far and the re-action would cause the pipe to "buck" or fly around in a contrary direction. The same re-action would also often occur in elevating or depressing the pipe.

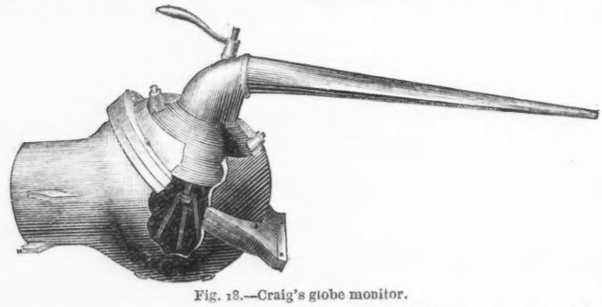

Fig. 18.—Craig's globe monitor.

The next improvement was Craig's globe monitor. This invention consists of a hollow ball or globe, with an opening on one side, into which enters the main supply pipe, and one on top, out of which an elbow-joint protrudes. One end of this elbow is attached to a socket which revolves on the interior of the globe, and at the same time creates a water-tight joint. This joint enables the operator to change the direction of the stream from point to point at pleasure. To the other end of the elbow is attached the discharge-pipe, which may be of any size desired. The ball revolves entirely round horizontally, and up or down at an angle of about 40 degrees.

The next machine introduced was Hoskin's dictator, in which the parts constituting the joint work with an external, instead of an internal, connection ; that is, the pressure of the water, instead of forcing the parts of the joints together, tends to force them apart, and the joint, to keep it from leaking, is provided with an elastic packing. Both rotary and vertical motions are facilitated by the peculiar construction, wheels reducing the friction on the former, and the latter turning on pivots. This joint is still much used ; the only objection to it is the unnecessary loss of power, on account of the elbows being too abrupt.

Another machine, under the name of Watson's champion, similar in design to the last mentioned, was introduced, but denounced as an infringement on the dictator, and put under injunction.

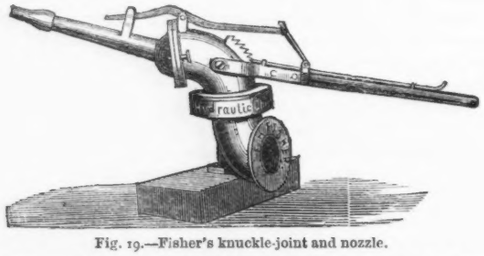

Fig. 19.—Fisher's knuckle-joint and nozzle.

Another new machine entered the field under the name of the knuckle-joint and nozzle, invented by Mr. F. Fisher, of Nevada County, California, consisting of two elbows, placed in reversed position when standing in right line, but made to revolve by a ring in which there is a series of anti-friction rolls, the ring being slipped down over the top of the lower elbow, and then held in its place by a flange bolted to the top of the lower elbow. The ring is then bolted to a flange on the top elbow, thereby connecting the two, and at the same time leaving the top elbow free to move around in a complete circle. When the water is let into the elbow, the pressure brings the rolls in the ring up against the flange on top of the bottom elbow, allowing the top elbow to move around easily and without any friction, except that of the rolls themselves. A piece of rubber packing placed between the flanges of top and bottom elbows, makes the joint tight by the pressure of the water against the ring. In the outlet or top elbow is a knuckle-joint, which permits the up-and-down motion of the discharge-pipe. It is a concave surface fitted to a convex one ; the concave has an opening for the pipe to pass through. The pipe is screwed into the convex surfaces and will move up and down, while the concave one is bolted firmly to the flange on the top elbow.

The elbow and knuckle-joint are made of cast iron from ⅜ to ¾ inch thick. The discharge-pipe is made of No. 16 iron, 8 feet long, with cast-iron nozzle. The machine is operated by a lever 10 or 12 feet long, with two arms, and attached to the top elbow by trunnions. A lever is pivoted to the top of the upper elbow and attached on one end to the discharge-pipe by a strap inclosing the pipe, and provided with two rolls on the top for the lever to slip on. At the other end it is connected with the operating lever by a short upright lever, made to work loose on its joints. Thus the up-and-down motion is imparted to the discharge-pipe by the rise and fall of the operating lever. By moving it to the right or left, the whole machine, except the bottom elbow, is moved. A little device is attached to the lever to hold the discharge-pipe in position when the water is off. It is a catch working in a ratchet on the top elbow, attached by a rod running out on the lever, so that the operator can put it in or out as the case may be.

The pipe stands firmly in place when the water is on ; the operator, standing at the end of the lever, can easily direct the stream to any point—good execution being done at a distance of 200 feet from the bank, thus securing safety o life from caves, which are so frequent and so often fatal, where small streams are used against high banks. These machines are made to throw streams of from 4 to 7 inches in diameter.

Fig. 20.—Hoskin's Little Giant.

The Little Giant, invented by Mr. R. HOSKIN, of Dutch Flat, Placer County, is claimed to combine all the requisites of the hydraulic nozzle.

Simple in its arrangements, it is easily managed, and an additional pressure of water does not interfere with its motion, as the connections, or joints, instead of being forced together, are forced apart by such a pressure. The avoidance of abrupt angles in its construction makes the Little Giant approach nearer to the straight line than any other hydraulic machine so far introduced.

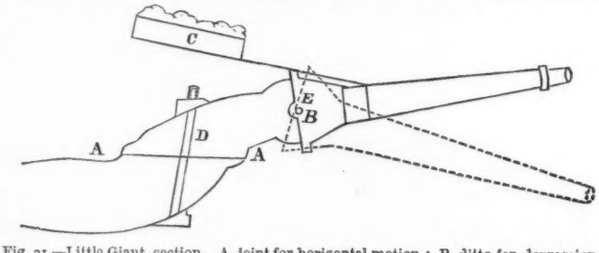

Fig. 21.—Little Giant, section. A, joint for horizontal motion ; B, ditto for depression or elevation ; C, balance-box to keep pipe in place ; D, E, bolts.

Upon the strength of this fact, it is claimed, and apparently with good reason, that less resistance is offered to the flow of water by the Little Giant than by any other hydraulic apparatus, and that by it, therefore, not only a greater quantity of water, but also a far more powerful stream, can be discharged.

The joints, being packed with leather, are dependent on the packing for tightness, and are thus preserved from wearing or grinding out. To prevent this rotary motion of the water, produced whenever the elbows are turned different ways, the "rifle," composed of radial plates, is inserted in the discharge-pipe. These plates force the water to issue in a straight line from the discharge-pipe, and prevent thus the scattering or breaking up of the stream, on the solid and columnar shape of which so much of its effectiveness depends.

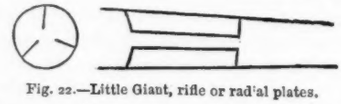

Fig. 22.—Little Giant, rifle or radial plates.

The Little Giant has been worked with 6-inch nozzle under a pressure of 435 feet.

Distributer.—This is a strong cast-iron box, receiving directly from the supply-pipe all the water to be used by means of hydraulic machines in the mines. It is provided with two or more openings, to which the pipes, directly connected with the hydraulic nozzles, are attached. These openings can be closed by strong iron gates, raised or lowered by means of a screw. To change the water from one hydraulic nozzle to another the gate for the latter is opened by turning the screw. At this point two streams of equal power will issue from the two nozzles. Now, the screw of the first hydraulic nozzle is turned, the

gate closes slowly, and the whole of the water is changed from one nozzle to the other.

These distributers are provided with as many as four gates, so that four hydraulic nozzles could be supplied from one of them, provided the supply of water and the feed-pipe were large enough to furnish the four nozzles at the same time. The distributer must be firmly fixed to the ground.

The supply or feed pipe.—The size of this pipe must necessarily depend on the supply of water. In mines which use from 1,500 to 2,000 inches of water, feed-pipes of 22 inches diameter are generally used. When the supply of water is higher than that, and rises to 3,000 inches or more, it is advisable to use a pipe of 30 inches diameter, since the friction is lessened to a great extent by the large size.

The feed-pipe should descend from a strong bulk-head in as direct a line as possible, and with the least angles, to the mine. It should not be permitted to *fall* and *rise* again, unless this is unavoidable; and then it should be provided with an extra number of air-valves, with *brass* floats. (The depressed portion of the pipe would retain the water all the time, and might be at any moment the cause of a collapse, unless efficient air-valves could supply air quick enough to prevent a vacuum. These air-valves ought to be provided with brass, *not wooden*, floats, since the swelling of the latter will, under some circumstances, wedge them so tightly in the valve that the atmospheric pressure is unable to remove them; a collapse is the consequence.)

The water at the bulk-head must cover the mouth of the pipe for a depth of 3 or 4 feet, to lessen the amount of air, some of which, under all circumstances, will enter with the water. Where the feed-pipe has a permanent position, it is the best plan to have joints riveted together; that part of the pipe which is liable to be shifted must be connected by hooks and wire, and the joints must be calked carefully. The pipe must be placed in such a position that it is immovable; on precipitous ground, braces and frame-works, weighted down with stones, ought to be used at intervals. An air-pipe must be attached to the feed-pipe at or near its upper end.

The iron used for these feed-pipes, varies from No. 16 to No. 11, and lower, according to the greater or less pressure; however, care should always be taken not only to employ the best charcoal-iron, but also to have it strong enough against all chances.

For a 22-inch pipe, No. 16 iron was used for pressure up to 150 feet; No. 14 from 150 to 250 feet; No. 12 from 250 to 310 feet. For a 30-inch pipe, No. 14 iron was used for pressure up to 150 feet; No. 12 from 150 to 275 feet.

The pipes supplying the hydraulic nozzle from the distributer will differ in size, say from 10 to 15 inches; must be made of No. 14 or No. 12 iron, and must be connected either by flanges or by hooks and wire; well calked and firmly secured in their position.

All the pipes should be protected by immersion in Dr. Angus Smith's preparation of coal-tar.

THE EXTRACTION OF GOLD.

The use of quicksilver.—Quicksilver is used to collect and combine small particles of gold, in the form of amalgam. To facilitate this action it is necessary to use it in such a way that it may be constantly exposed to a contact with these minute particles of gold. For this reason the washing through the sluice-boxes must commence before any quicksilver is used, so as to get the interstices between the riffles filled with small gravel, sand, clay, &c.

This washing without quicksilver may be carried on for a day, and light top-gravel will be the best material to use.

After the openings in the different riffles are thus filled, so as to prevent the quicksilver from dropping clear to the bottom of the sluices, it may be applied, for the first charge, with a liberal hand. From 500 to 600 pounds are used for a sluice of 5,000 feet length. The upper parts of the sluice are generally charged more profusely than the lower parts, as a portion of the quicksilver is carried down by the stream.

The quicksilver must be scattered in a light spray all along the sluices; iron sprinkling-pots, made for the purpose, are used with good effect. The charging of the sluices is generally attended to twice a day; but it must be admitted that a more liberal and more frequent application of quicksilver would be only beneficial. The daily charges of quicksilver are reduced to about 100 pounds, so that a supply of one hundred flasks of quicksilver (about 74 pounds per flask) will last for a six months' run, allowing for the quicksilver regained by the semi-monthly cleaning up of the upper part of the sluice-boxes.

Cleaning up.—The upper part of the sluice, provided with either scantling-riffles or block-riffles, is generally cleaned up once or twice per month. Whenever this is resolved upon the sluices are gradually emptied of their gravel contents down to the riffles, and these are removed successively, commencing with the upper riffle.

A small stream of water is applied to move gently the black sand, or fine gravel, which may remain in the sluices. The amalgam or quicksilver is scooped up and put in wooden or iron buckets. Here and there pieces of scantling are placed across the sluice to check the flow of the quicksilver. Brooms, scrapers, and knives are used to collect the amalgam which may hide in small fissures of the wood. A general cleaning up takes place once or twice a year, when the whole line of sluices is deprived of its gold and quicksilver.

The riffles, whatever they may be, are put alongside the sluices, ready to be replaced for new service.

Cleaning the amalgam.—The amalgam must be placed in a quicksilver-bath to separate the gold from any baser metal, particularly lead, which has been scattered by the hundred pounds over the hill-sides of California by quail and rabbit hunters. The amalgam must be well broken up, and rubbed and washed repeatedly. In this way the gold, as the heaviest part, will settle to the bottom, and all the other metallic substances will float on the top of the quicksilver. After this washing the amalgam is deprived of the free quicksilver by straining through a filter of canvas, and afterwards put in a bath of water and sulphuric acid (one-third acid and two-thirds water) and boiled and stirred over a slow fire for about forty minutes. By this process the remaining lead is generally removed, and the amalgam, after further washing in pure water, may be considered clean.

The residue (skimming) of lead, etc., is put in pure nitric acid, which destroys the lead, forming a nitrate of lead; the amalgam remains, and is cleaned by a water-brush.

Retorting.—After the amalgam has been purified it is ready for retorting. The retort is covered on the inside with a thin layer of moist clay to prevent the gold from sticking to the sides, after which the amalgam is packed tightly into the retort and the latter placed on the fire. A pipe leading from the retort into an iron bucket, filled with clean water, conducts the vaporized quicksilver into the water where a condensation takes place immediately. Five or ten minutes after the flow of quicksilver has stopped, provided the retort has been all the time exposed to a brisk fire, the retort may be removed from the furnace, and the amalgam has been changed into a cone of pure gold.

Great care must be taken to close hermetically the retort containing the amalgam, as the escaping quicksilver-vapors are very poisonous.

Smelting.—The retorted gold is broken in fine pieces, placed in a crucible, and, after some flux is added, exposed in the furnace to a hot charcoal fire. After a perfect fusion has taken place, the liquid gold is cast in a mold, generally the shape of a small brick. After cooling, the bar is stamped with the name of the mining company and the weight, and is ready for the mint or assay office.

TO BE CONTINUED.

Notes.

Kaolin in the United States.—Thirty-five miles from Omaha, Neb., there is a deposit of kaolin, about 30 feet thick and underlying about 100 acres. It crops out along a bluff for over half a mile, with but a few inches of earth covering it. Beginning at the top, it is coarse and of a granulated nature; but as we descend, it grows finer and is very fine and white near the bottom. It quarries in lumps, like chalk, and very readily dissolves in water. Pure and free from foreign substances, it readily becomes pliable, and can be turned or molded into almost any form; and its shrinkage in drying is remarkably small. The difference of grades in fineness adapts it to the manufacture of a very large class of goods, such as are in demand throughout the West; and as it lies near the Burlington and Missouri Railroad, shipping facilities are convenient. It makes a beautiful white brick, suitable for fronts and trimmings; and it seems well adapted for terra cotta, chimney tops, drain pipes, and all classes of jugs, crocks, etc., and is very superior for fire bricks. This immense deposit, located as it is with timber, water, and all conveniences for manufacturing, offers, I think, a good opening for some capitalist to build up an immense business.—*Correspondent Scientific American.*

The Alleged Parallelism of Coal Beds—by J. J. STEVENSON.—Mr. STEVENSON gives examples, from this country and England, of the subdivision of coal beds, and of variations in the thickness of the intervening rock strata. The interval between the Upper Freeport and Kittaning coal beds along Yellow Creek in Ohio varies from 80 to 160 feet in five miles. The same interval on Wells Creek varies in one mile from 8 feet to 28, and from this it enlarges beyond [distance not stated] to 100 feet. In six sections given by Prof. ROGERS in his Pennsylvania Report the intervals are 184, 143, 142, 117, 109, 103. The total interval between the Pittsburgh coal bed and the Upper Freeport varies in Ohio from 420 feet at the west to 505 at Steubenville; in Pennsylvania it is 200 feet at Ligonier, 220 at Elk Lick, and 450 to nearly 600 feet on the Monongahela River; in West Virginia, along the Monongahela and Tygart's Valley River, it varies not much from 420 feet. Mr. STEVENSON, after stating many other facts, observes, in conclusion, that the variation in thickness arises mainly from the fact that the beds were deposited in a great trough having the Cincinnati uplift on one side and the Alleghany region on the other; that the diminution in thickness is quite regular east and west from the middle of the trough; that the subsidence as a whole was regular, approaching uniformity, but that there were "bulgings or other irregularities such as could not fail to accompany any operations so extensive." He further concludes that "all the coals of the Upper Coal group are offshoots from one continuous marsh, which existed from the beginning of the era to its close, and which in its full extent is now known as the Pittsburgh coal seam."

Manufacture of Wire Rope in San Francisco.—There are two manufactories in this city, viz: The Pacific Wire Rope Manufacturing Company, an incorporated company, and the long established house of A. S. Hallidie. Together they give employment to 50 men, require 60 horse-power, and turn out 75 tons of manufactured goods each month, valued at $30,000. The machinery of both establishments is most complete, and of the latest patterns. Wire, for all the uses of this country and for export, is manufactured—from the finest sizes used in weaving to the heaviest machine wire. The wire used for constructing the government telegraph line in Arizona, 650 miles in length, as well as the wire used in constructing the Northern Pacific telegraph line from Saucelito to Humboldt Bay—350 miles long—was made at the Pacific Wire Company's Works. All the requirements of the mining and shipping interest for wire rope and cordage are supplied from the manufactories in this city. There is scarcely sufficient demand to keep one large concern fairly running yet, but this business is growing in proportion with the country. All the demand for home consumption and export, however, is fully met; the competition between the importers and manufactories keeps the margin for profitable business very close. Very small wire cords (1-16 inch thick) are made for window cords, and large cable (2 inch thick) for mining purposes, to 4 inches thick for suspension bridges, all of which are supplied from these manufactories. While the above concerns report a fair business during the year just closed, they also report having experienced some drawbacks from the fluctuation in the iron market.

THE ENGINEERING AND MINING JOURNAL.

NEW YORK, SATURDAY, APRIL 10, 1875.

RICHARD P. ROTHWELL, C. E., M. E., } Editors.
ROSSITER W. RAYMOND, Ph. D., }

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Tests of American Iron and Steel.

WE are pleased to note the appropriation of $50,000, at the last Session of Congress, for the purpose of making a series of tests of the strength of American iron and steel used in engineering structures. This appropriation was made in answer to a memorial to Congress, made in January last by the American Society of Civil Engineers, in which "the importance of a thorough and complete series of tests of American iron and steel, and the great value of formulas to be deduced from such experiments" was urged upon the United States Government. It is generally admitted that the results obtained in tests of European irons do not obtain with the irons made from different ores, and in some cases by different processes, in this country. We might go further even and say that as the manufacture of iron is improved, and the forms in which it is used multiply, there is need of a new series of experiments in every country, to determine the strength which can be obtained in the usual application of the metal in construction.

The formulas in general use were, for the most part, deduced from experiments on small laboratory samples and do not correctly represent the strength of iron and steel in pieces of the forms and dimensions used in practice, so that, while unquestionably these formulas have been of great use in proportioning the parts of engineering structures, they have at most been but rough approximations of the practical strength of the material. It must be evident that much is lacking in a knowledge so imperfect that we dare use as working load but one-tenth or one-fifth of the actual strength of an average quality of the material employed.

A work which is for the benefit of the whole country, as this would be, should properly be carried out by an authority above the suspicion of personal interest which might attach to experiments made by private parties. Moreover, such a set of experiments will run over many years and will necessarily involve the expenditure of larger amounts of money than either private individuals or companies can afford. It is therefore eminently proper that the general government which is also the party most largely interested in the results should undertake the important work.

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There is no doubt, the miners of the Lehigh Region are acting in a very violent manner. We are well-informed that they have made demonstrations with the view of stopping the pumps at two of the Audenried slopes, and at Beaver Brook, Yorktown, Jeddo, Eckley, Upper Lehigh, Drifton and other places. Messrs. COXE BROS., proprietors of Drifton, having had the men driven off from their new slope, at once took out the pumps and let it fill up, the miners in this case having been taken at their word so promptly, that their tools remained in the mine. The demonstrations continue to increase in violence, rather than diminish, and the presence of the military is considered necessary to preserve order. Yesterday, 6th April, 150 armed special police from Philadelphia arrived at Hazleton, from whence they will be distributed among the collieries. We have this morning been advised by telegram of fresh demonstrations, and that a large number of troops will be at once sent to the scene of disorder—two regiments, it is said—one from Philadelphia, another from Chester—are under orders to move at once. Undoubtedly, there is much exaggeration in the reports that appear in the city, and even in the local, papers; it is, nevertheless, very certain that the situation is quite serious, and is bringing great discredit on the Miners' Union, which, however it may disavow in "resolutions" these violent proceedings, yet countenances, if it does not officially originate, them. When the President of one of the local boards of the Union in the Hazleton Region marches at the head of one of these riotous armed mobs, and he is neither expelled nor interfered with in his official capacity, it is useless for the leaders to publish "resolutions" or disavowals of the participation of the Union in these unlawful acts. The military will, doubtless, bring order into the region, but the great question of resumption of work remains still in abeyance. In the Wilkesbarre Region, the men have, with the exception of a few unimportant demonstrations, acted with great moderation. It is "the quietest strike that has ever been known here," and it is quite improbable that any such violent proceedings as have characterized the Lehigh Region, could ever be enacted in the Wyoming Valley, where the relative proportion of persons not engaged in mining is much greater than in the mining villages of the Lehigh. The question that is asked, whenever the subject is brought up in conversation, is "What is the prospect of the men going to work?" And it is a question exceedingly difficult of satisfactory solution. We have, after mature consideration of the subject, steadily advised the men to accept the wages offered and to go to work. In no other branch of industry can they to-day earn anything like the wages the miners are now offered. We make no wild statements in this matter, but have gone for our facts to the pay-rolls of the mines, and have taken therefrom a number of names in the order as they came on the roll. In the following table we give the net earnings for the month of February, 1875—after deducting wages paid by the miners to their laborers, and general mining expenses, such as powder, oil, wicking, etc.,—of *miners* cutting coal by the ton on the reduced wages now offered, and which these men struck against on the 1st of March, after having worked two months at them. The month of February had but 24 working days, and it appears from the pay-rolls that the miners in question worked generally 23 days; where they did not work full time, it was their own act, and not the wish of the company:

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These are, in each case, the net earnings of each of two partners, and certainly cannot be called starvation wages. They are, be it understood, *Miners'* wages; laborers were paid as follows:

Inside labor	$1 95 per day.
Outside "	1 50 "
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Miners working by the day on company work received $2.25 per day. Owing to the great superabundance of labor at the mines, these men did not usually work full time, and, consequently, their earnings were really small, and, probably, would not average one-half that of the miners; yet their work is quite as dangerous—where they work inside—and much more arduous than that of their better paid fellows. As a rule, a miner completes his day's work in from 6 to 8 hours; it is a very rare thing for him to remain in the mines after two o'clock, when he goes in at seven, and expert workmen frequently get done by twelve

o'clock. The amount of coal *they limit themselves to cut* is from 10 to 14 tons (5 to 7 cars) per day, varying somewhat with the nature of the coal and the conditions of the vein. Their laborers, who load the coal into the cars, have to work much harder and longer hours than the miners, and yet they receive very much less for their work. To sum up, the *miner, i. e.*, the man who cuts the coal is, even at the reduced wages offered, much better paid than any other class of labor in the country; the laborer, who works at day wages in and about the mines is paid very moderate wages, and actually earns less, on account of loss of time, than he might do on other work at lower rates.

The result of this is evidenced in the facts that there is at present much destitution among the laborers in this and other regions on strike, but the miners are so well off that the large number of them who have money in the savings banks have not yet drawn upon these resources. So far as they are concerned, there is no doubt they could keep up the strike for several months yet; this, however, would entail an immense amount of suffering among all the other laborers employed about the collieries. So far as any expression of opinion is made by the men, they appear to be very determined in their resistance to the proposed reduction. On the other hand, the companies appear to be inflexible in their determination to insist on this reduction, and it can scarcely admit of a doubt that the companies will carry their point; the question is simply one of how much each side will lose in the strife. Were the men to receive to-day what they ask, they would never regain what they have lost, and on the other hand it would appear that the general decline in wages throughout the country fully justifies the companies in the reduction they propose. A personal examination into the case confirms the impression we have already expressed that this is a case in which a little more *conciliation* and a little less *dictation* on each side would have a very beneficial result. The figures we have from time to time published establish the fact that the wages offered the men are not only fair living wages, but are higher than they can earn in other industries. They are in no sense "starvation wages." On the other hand, the lordly way in which some of the operators assert "their right to manage their own property as they see fit, and to offer such wages as they may please; that they understand their own business best, and need no advice as to what they should pay and what they should not pay; that if the men don't like what is offered them they need not accept it, etc., etc.," tends to cement the men together in their opposition, and, in our judgment, is an expensive and unsatisfactory way of bringing about a solution of the difficulty. If the companies and men would discuss the points of difference in a court of conciliation and arbitration, we believe the results would be of advantage to both sides, though probably not confirming the expectations of either. In a word, we are very firmly convinced that the "heroic style" adopted by the companies of treating such subjects is expensive and irritating, and that it would be better to recognize the fact that though a large number of the laboring classes about the mines are men without education and allow themselves to be led away by designing demagogues, they are, nevertheless, amenable to reason, and more easily convinced by fair words and consistent acts than by force or starvation. Many of the leaders are doubtless blatant demagogues, and we believe a very large majority of the men would to-morrow go to work, were it not for intimidation in some form. But the course of the companies appears to us to strengthen rather than reduce the influence of these men, and it would be well for both sides to remember that neither has a monopoly of wisdom, and neither is infallible in its conclusions.

Economy in Pumping Engines.

THERE are few questions that a mining engineer should so thoroughly understand as that of pumping, and yet it is probably the question about which there is the least knowledge in the profession. At the deep mines of the Comstock and other Western mining regions, the cost of pumping has become enormous, and justifies the investment of millions of dollars in driving drainage tunnels; in our anthracite mines, the first cost of the pumping machinery for a shaft of 500 to 600 feet in depth not unfrequently exceeds $100,000; the importance of the subject is therefore manifest. The question of the best kind of pumps for any given work is not to be solved by any general rule, for it will depend on the special conditions of each case. If fuel be abundant and cheap, the best pump will be one in which the questions of simplicity, reliability and cheapness take precedence of economy in the use of fuel, while, if fuel be expensive, it may be desirable to establish pumps of an expensive and complicated construction, if by so doing we can secure, in addition to reliability, a considerable increase in the amount of effective work from a given expenditure of fuel. Engineers too often go to one or other of two extremes. One class is so conservative as to reject all innovations on the pumps that "were good enough for our forefathers;" that is, they want a pump that "will run without stoppage or break-down;" and they usually get one whose parts are ill proportioned and excessively heavy and in which the consumption of fuel for the performance of a given work may be four or five times that of a first-class pumping engine. The other class of engineers consists of the theorists or inexperienced persons who become dazzled with the mirage of "a hundred million duty" and overlook the cost of obtaining the coveted figures. Between these extremes is the mean of sound judgment and enlightened experience which carefully weighs total cost of lifting a given amount of water to the desired height, and selects the machine that will best accomplish this, even though it may not be the most economical in the use of fuel. Other things being equal, we should prefer the engine giving the highest duty, but it is quite possible to pay more for high duty than it is worth.

We have, from time, to time called attention to the performances of some of our most important city water works' pumping engines, because, as a rule, in this country, the most perfect engines we have are used for this purpose. We have had occasion to note in some of these cases an exorbitant expenditure of money to attain a small saving of coal; the desire to build monuments of magnificent machines to themselves, regardless of cost, being the besetting weakness of waterworks engineers. Now we would not in any way discourage the attempt to secure greater economy in the use of fuel in pumping engines; there is great room for improvement in this respect in even our best engines, but economy of fuel is but one item among several which should all receive equal attention. To revert to the question of waterworks' pumping machinery: We have before us the report of commissioners appointed by the City Council of Lawrence, Mass., to investigate the cause of the excess of expenditure over authorized cost in building the waterworks of that city. With more than usual intelligence and discretion, they have carefully avoided condemnation or criticism of work or contracts already well advanced and to which the city was committed, giving their reasons therefor in the following discreet manner: "Your committee were obliged to take accomplished results as they found them, not as they might have been had other heads planned, and other hands executed, the work already done. They were also confronted by the fact that former governments have given those plans their approval, or have silently permitted the works to be completed to that extent which precludes the practicability of material change unless the plans are defective or expensive to a dangerous degree in work proposed." The general effect of their report is to exonerate the commissioners from intentional wrongdoing or favoritism, while it more than hints at their lack of judgment in making so large an expenditure. This will not be wondered at by those of our readers acquainted with such work, when they learn "that from the plans of the foundations it appears that those for the pumping engines and their house go down 22 feet below the post plates which support the engine and 52 feet below the bed stone upon which the engine rests. The engineer states that there have been used about 600,000 bricks in the foundation of the pumping engines." A reasonably good house for protecting the engines, and a shed-like structure for storing coal is all that is either necessary or usually provided. Yet, in this case, we are told that the cost of foundations, without buildings, was nearly *one-tenth* the estimated cost of the whole works.

It appears that the contract for the engines was given out without advertisement or competition, it being merely stated that the "Commissioners decided that the Leavitt engines, so-called, were so superior in point of merit to all others, as to warrant the proceeding." This very important decision of a question that has so long agitated the engineering world will, doubtless, be worth the large sum it has cost the City of Lawrence, if only it be not reversed in the higher court of experience. The annexed testimony of Mr. WORTHINGTON suggests a doubt in this direction.

We briefly notice the declaration of Mr. BALL, the Consulting Engineer of the Commission, that from the table of cost of raising one million gallons one foot high, "the cost of raising any given quantity to a given height, may be obtained by simple multiplication." We would suggest that this cost is greatly modified by the quantity raised per day; the expenses, such as wages, heating, lighting, and repairs, do not increase exactly as the quantity delivered; nor is the cost of coal uniform, nor does the large percentage inevitably wasted in banking and firing (which was 23 per cent. of the total quantity used at Lynn in 1874) increase directly as the quantity of water raised. As it stands, this is a very misleading statement, and should be qualified.

In another place, Mr. BALL gives a table of resistance from friction in water pipes, which he makes to increase exactly as the square of the velocity. This is so widely at variance with recorded results, that we would like to know more of the facts on which the assertion is based.

Mr. BALE disapproves, in the following sensible words, of the project of the Commissioners to tunnel a high hill for the purpose of getting a uniform ascent upon the force main: "While it is an advantage to have the grade of a force main so arranged that it can be drained by a gate at the pumping-station, it is not a necessity so pressing that it must be obtained at whatever cost the location may demand." Subsequently he speaks of it as being particularly desirable when a "Leavitt engine" is used, where the air used in the water cylinder to cushion the stroke of the piston is to be disposed of; this, he says, can be done by "air valves or a stand pipe." This seems to be a new requisition. We have seen a statement in the Report of Duty Trial of the Leavitt engine at Lynn, that a certain small percentage (4, we think, was given) was admitted to the pumps for the purpose of keeping the air chambers supplied. To the important question, "Whether the engines can be used for pumping directly into the mains at high pressure for fire service?" Mr. BALL makes the prudent answer that they can, "*provided they are properly adapted to the purpose.*" We have respect for this proviso, in view of some latter-day experience in direct pumping!

Mr. BALL gives the cost of raising one million gallons one foot high at Lynn at 7.16 cents. A report of the Philadelphia Works for 1873, which he cannot have seen, gives the cost at 7c. This would qualify his declaration that "The cost of lifting water at Lynn is the best yet attained."

In general, his conclusions appear in a moderate way to justify the adoption of the "Leavitt engine," on the ground of superior economy. On this point he is opposed by Mr. WORTHINGTON, patentee of the Duplex engine, whose testimony we find printed in the Lawrence *American*, dated March 26. We append this important correspondence. Mr. WORTHINGTON'S reputation as a mechanical en-

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RICHARD P. ROTHWELL, C. E., M. E., } Editors.
ROSSITER W. RAYMOND, Ph. D., }

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Tests of American Iron and Steel.

WE are pleased to note the appropriation of $50,000, at the last Session of Congress, for the purpose of making a series of tests of the strength of American iron and steel used in engineering structures. This appropriation was made in answer to a memorial to Congress, made in January last by the American Society of Civil Engineers, in which "the importance of a thorough and complete series of tests of American iron and steel, and the great value of formulas to be deduced from such experiments" was urged upon the United States Government. It is generally admitted that the results obtained in tests of European irons do not obtain with the irons made from different ores, and in some cases by different processes, in this country. We might go further even and say that as the manufacture of iron is improved, and the forms in which it is used multiply, there is need of a new series of experiments in every country, to determine the strength which can be obtained in the usual application of the metal in construction.

The formulas in general use were, for the most part, deduced from experiments on small laboratory samples and do not correctly represent the strength of iron and steel in pieces of the forms and dimensions used in practice, so that, while unquestionably these formulas have been of great use in proportioning the parts of engineering structures, they have at most been but rough approximations of the practical strength of the material. It must be evident that much is lacking in a knowledge so imperfect that we dare use as working load but one-tenth or one-fifth of the actual strength of an average quality of the material employed.

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The result of this is evidenced in the facts that there is at present much destitution among the laborers in this and other regions on strike, but the miners are so well off that the large number of them who have money in the savings banks have not yet drawn upon these resources. So far as they are concerned, there is no doubt they could keep up the strike for several months yet; this, however, would entail an immense amount of suffering among all the other laborers employed about the collieries. So far as any expression of opinion is made by the men, they appear to be very determined in their resistance to the proposed reduction. On the other hand, the companies appear to be inflexible in their determination to insist on this reduction, and it can scarcely admit of a doubt that the companies will carry their point; the question is simply one of how much each side will lose in the strife. Were the men to receive to-day what they ask, they would never regain what they have lost, and on the other hand it would appear that the general decline in wages throughout the country fully justifies the companies in the reduction they propose. A personal examination into the case confirms the impression we have already expressed that this is a case in which a little more *conciliation* and a little less *dictation* on each side would have a very beneficial result. The figures we have from time to time published establish the fact that the wages offered the men are not only fair living wages, but are higher than they can earn in other industries. They are in no sense "starvation wages." On the other hand, the lordly way in which some of the operators assert "their right to manage their own property as they see fit, and to offer such wages as they may please; that they understand their own business best, and need no advice as to what they should pay and what they should not pay; that if the men don't like what is offered them they need not accept it, etc., etc.," tends to cement the men together in their opposition, and, in our judgment, is an expensive and unsatisfactory way of bringing about a solution of the difficulty. If the companies and men would discuss the points of difference in a court of conciliation and arbitration, we believe the results would be of advantage to both sides, though probably not confirming the expectations of either. In a word, we are very firmly convinced that the "heroic style" adopted by the companies of treating such subjects is expensive and irritating, and that it would be better to recognize the fact that though a large number of the laboring classes about the mines are men without education and allow themselves to be led away by designing demagogues, they are, nevertheless, amenable to reason, and more easily convinced by fair words and consistent acts than by force or starvation. Many of the leaders are doubtless blatant demagogues, and we believe a very large majority of the men would to-morrow go to work, were it not for intimidation in some form. But the course of the companies appears to us to strengthen rather than reduce the influence of these men, and it would be well for both sides to remember that neither has a monopoly of wisdom, and neither is infallible in its conclusions.

Economy in Pumping Engines.

THERE are few questions that a mining engineer should so thoroughly understand as that of pumping, and yet it is probably the question about which there is the least knowledge in the profession. At the deep mines of the Comstock and other Western mining regions, the cost of pumping has become enormous, and justifies the investment of millions of dollars in driving drainage tunnels; in our anthracite mines, the first cost of the pumping machinery for a shaft of 500 to 600 feet in depth not unfrequently exceeds $100,000; the importance of the subject is therefore manifest. The question of the best kind of pumps for any given work is not to be solved by any general rule, for it will depend on the special conditions of each case. If fuel be abundant and cheap, the best pump will be one in which the questions of simplicity, reliability and cheapness take precedence of economy in the use of fuel, while, if fuel be expensive, it may be desirable to establish pumps of an expensive and complicated construction, if by so doing we can secure, in addition to reliability, a considerable increase in the amount of effective work from a given expenditure of fuel. Engineers too often go to one or other of two extremes. One class is so conservative as to reject all innovations on the pumps that "were good enough for our forefathers;" that is, they want a pump that "will run without stoppage or break-down;" and they usually get one whose parts are ill proportioned and excessively heavy and in which the consumption of fuel for the performance of a given work may be four or five times that of a first-class pumping engine. The other class of engineers consists of the theorists or inexperienced persons who become dazzled with the mirage of "a hundred million duty" and overlook the cost of obtaining the coveted figures. Between these extremes is the mean of sound judgment and enlightened experience which carefully weighs total cost of lifting a given amount of water to the desired height, and selects the machine that will best accomplish this, even though it may not be the most economical in the use of fuel. Other things being equal, we should prefer the engine giving the highest duty, but it is quite possible to pay more for high duty than it is worth.

We have, from time, to time called attention to the performances of some of our most important city water works' pumping engines, because, as a rule, in this country, the most perfect engines we have are used for this purpose. We have had occasion to note in some of these cases an exorbitant expenditure of money to attain a small saving of coal; the desire to build monuments of magnificent machines to themselves, regardless of cost, being the besetting weakness of waterworks engineers. Now we would not in any way discourage the attempt to secure greater economy in the use of fuel in pumping engines; there is great room for improvement in this respect in even our best engines, but economy of fuel is but one item among several which should all receive equal attention. To revert to the question of waterworks' pumping machinery: We have before us the report of commissioners appointed by the City Council of Lawrence, Mass., to investigate the cause of the excess of expenditure over authorized cost in building the waterworks of that city. With more than usual intelligence and discretion, they have carefully avoided condemnation or criticism of work or contracts already well advanced and to which the city was committed, giving their reasons therefor in the following discreet manner: "Your committee were obliged to take accomplished results as they found them, not as they might have been had other heads planned, and other hands executed, the work already done. They were also confronted by the fact that former governments have given those plans their approval, or have silently permitted the works to be completed to that extent which precludes the practicability of material change unless the plans are defective or expensive to a dangerous degree in work proposed." The general effect of their report is to exonerate the commissioners from intentional wrongdoing or favoritism, while it more than hints at their lack of judgment in making so large an expenditure. This will not be wondered at by those of our readers acquainted with such work, when they learn "that from the plans of the foundations it appears that those for the pumping engines and their house go down 22 feet below the post plates which support the engine and 52 feet below the bed stone upon which the engine rests. The engineer states that there have been used about 600,000 bricks in the foundation of the pumping engines." A reasonably good house for protecting the engines, and a shed-like structure for storing coal is all that is either necessary or usually provided. Yet, in this case, we are told that the cost of foundations, without buildings, was nearly *one-tenth* the estimated cost of the whole works.

It appears that the contract for the engines was given out without advertisement or competition, it being merely stated that the "Commissioners decided that the Leavitt engines, so-called, were so superior in point of merit to all others, as to warrant the proceeding." This very important decision of a question that has so long agitated the engineering world will, doubtless, be worth the large sum it has cost the City of Lawrence, if only it be not reversed in the higher court of experience. The annexed testimony of Mr. WORTHINGTON suggests a doubt in this direction.

We briefly notice the declaration of Mr. BALL, the Consulting Engineer of the Commission, that from the table of cost of raising one million gallons one foot high, "the cost of raising any given quantity to a given height, may be obtained by simple multiplication." We would suggest that this cost is greatly modified by the quantity raised per day; the expenses, such as wages, heating, lighting, and repairs, do not increase exactly as the quantity delivered; nor is the cost of coal uniform, nor does the large percentage inevitably wasted in banking and firing (which was 23 per cent. of the total quantity used at Lynn in 1874) increase directly as the quantity of water raised. As it stands, this is a very misleading statement, and should be qualified.

In another place, Mr. BALL gives a table of resistance from friction in water pipes, which he makes to increase exactly as the square of the velocity. This is so widely at variance with recorded results, that we would like to know more of the facts on which the assertion is based.

Mr. BALE disapproves, in the following sensible words, of the project of the Commissioners to tunnel a high hill for the purpose of getting a uniform ascent upon the force main: "While it is an advantage to have the grade of a force main so arranged that it can be drained by a gate at the pumping-station, it is not a necessity so pressing that it must be obtained at whatever cost the location may demand." Subsequently he speaks of it as being particularly desirable when a "Leavitt engine" is used, where the air used in the water cylinder to cushion the stroke of the piston is to be disposed of; this, he says, can be done by "air valves or a stand pipe." This seems to be a new requisition. We have seen a statement in the Report of Duty Trial of the Leavitt engine at Lynn, that a certain small percentage (4, we think, was given) was admitted to the pumps for the purpose of keeping the air chambers supplied. To the important question, "Whether the engines can be used for pumping directly into the mains at high pressure for fire service?" Mr. BALL makes the prudent answer that they can, "*provided they are properly adapted to the purpose.*" We have respect for this proviso, in view of some latter-day experience in direct pumping!

Mr. BALL gives the cost of raising one million gallons one foot high at Lynn at 7.16 cents. A report of the Philadelphia Works for 1873, which he cannot have seen, gives the cost at 7c. This would qualify his declaration that "The cost of lifting water at Lynn is the best yet attained."

In general, his conclusions appear in a moderate way to justify the adoption of the "Leavitt engine," on the ground of superior economy. On this point he is opposed by Mr. WORTHINGTON, patentee of the Duplex engine, whose testimony we find printed in the Lawrence *American*, dated March 26. We append this important correspondence. Mr. WORTHINGTON'S reputation as a mechanical en-

gineer, who brings to the question great experience and ability, lends great weight to his opinion. The following is the letter referred to :

LEVI EMERY, ESQ., MEMBER OF THE INVESTIGATING COMMITTEE, LAWRENCE MASS.

DEAR SIR :—In reply to your letter of March 16th, asking for information to be laid before your committee, I offer the following :—

To the question, "What has been your experience as a maker of pumping engines, and what proof have you to offer that they are good and reliable?" I answer, that I have been engaged in manufacturing the Duplex Pumping Engine for the last fifteen years. During that time I have erected about seventy of them at water works stations. With this I present a pamphlet containing a list of sixty of these engines, together with some testimony as to their merits. They are all working satisfactorily, and I do not know of a single serious accident that has happened to any one of them.

To the question, "What was said to you about bidding for our engine, and did you bid, or offer to bid?" I answer, In June, 1873, three gentlemen, two of whom were Messrs. BARBOUR & KNOWLES, of the Lawrence Water Commission, called at my office in New York, and obtained a verbal estimate for a pumping engine. They promised that I should hear from them when they were ready to negotiate definitely. Mr. BARBOUR called again sometime afterwards, and again assured me that I would be asked to bid for the engines at the proper time. On this I rested, and made no effort to obtain a hearing. I afterwards was informed at the office of the Board, that the contract had been awarded without advertisement or competition.

To the question, "At what price would you have offered to build two five million engines at the time when our contracts were made?" I answer, Thirty-five thousand dollars for each engine, including transportation, engine foundations, expenses of erection and starting.

To the question, "What duty would you have guaranteed?" I answer, Seventy millions,—if the competition seemed to turn upon that point, if otherwise, sixty-five millions.

To the question, "How long a time would you have required for completing the work?" I answer, Ten months.

To the question "What size, and state in general terms the cost, of necessary buildings for containing two of your engines, together with boiler house and coal shed, exclusive of pump well?" I answer, The cost is so much a matter of taste and architectural effect as to make it useless for me to attempt to state it. They need not be high nor massive, being in no way effected by the working of the engine. A building 45 by 50 would be about right for the engine house, and one of 35 by 40 for the boilers, The engine house should be about 20 feet high. I do not answer about coal sheds, not knowing how large a supply you may desire to store.

To the question, "How do you compare the values of different kinds of water works engines?" I answer, that I consider simplicity of construction, ease of management, and small liability to accident, as of the very first importance, compared to which all other considerations are secondary. The merits of an engine on these points cannot be expressed in figures, but as every approved type of engine has a record and a reputation to appeal to, the desired information can always be obtained. Next, I would compare the difference in cost between the proposed engines, assessing upon the difference a gross yearly percentage of 15 per cent. This includes legal interest, a percentage for a renewal fund, and also a percentage to express the annual cost of repairs and maintenance These two latter percentages are obviously matters of judgment. If we take 33½ years as the life-time of a pumping engine, it will be longer than would be assigned by most engineers. Three per cent. per annum is not, therefore, too large an assessment for a renewal fund which shall equal the original investment, when the engines are finally worn out or condemned. And during this long period, two or three new sets of boilers will be required, and the engine itself must also be practically renewed. Accidents, more or less frequent, and of greater or less severity, must also occur, and bring with them extraordinary expenditures. If, therefore, 5 per cent. per annum be taken to represent cost of repairs and maintenance, it will be less, I think, than is called for by the average record of first class pumping stations in any part of the world. On these grounds, I charge 15 per cent. per annum upon extra investment at the same time stating my conviction that it is not enough to cover.

To the question, "How would two of your engines compare, in financial results, with two engines, guaranteeing 95,000,000 duty on a duty trial, similar to the one at Lynn, and costing $131,000, including transportation, expenses of erection, and engine foundations?" I answer, I waive comparison on the points of simplicity of construction, reliable performance and diminished risk of accident, and thereby concede advantages which notably belong to the Duplex Engine, but which cannot be taken into a financial comparison. I compare, first, the cost of the engines ; second, the cost of fuel. No engine can equal, in its annual results, the duty obtained on a special trial. There are many reasons for this. The most important one is that the annual consumption includes much fuel wasted in banking, firing, heating buildings, etc., whereas the short duty trial only takes account of the coal actually consumed during the experiment. I, therefore, assume five-sixths of the guaranteed duty to represent the annual average duty. It may be safely taken as a very full allowance. The controlling consideration should now be not ced that a duplicate machine is always demanded for the safety of the works, long before the pumping capacity of the single engine is exhausted. To prove this I offer the following table:

	Act. Yearly Consumption.	Capacity of pumps.
Newark, 2 eng.	1.633,000,000	3,650,000,000
Charlestown, 3 eng.	2 83[illegible],000,000	6,470,0 0,000
Belmont, 3 "	1,960,000,000	6,470 000,000
Salem, 2 "	654,000,000	3,650,000,000
Cambridge, 2 "	749,000,000	3,650,000,000
Jersey City, 4 "	4,056,000,000	11,090,000,000
Cleveland, 2 eng. av. 16 year	623,000,000	3,650,000,000
Louisville, 2 " av. 12 year.	680,000,000	5,45 ,000,000
Brooklyn, 3 "	8,0[illegible]0,000,000	16,425,000,000

This table shows an average consumption of only 35 per cent. of the total pumping capacity, and this is too high, inasmuch as some of the works named are about to increase, or have increased, their capacity. But I take it as a basis on which to make the financial comparison called for in the question.

First, charge each engine with the cost of fuel required to pump 35 per cent. of the contract quantity calculated upon a "duty" equal to five-sixths of the guaranteed duty. Second, charge the more expensive engine with 15 per cent. per annum on its extra amount of first cost.

35 per cent. of 10,[illegible]00,000 gallons per day—1,277,000,000 per annum. To raise this amount 167 feet high would require :

At 80,000,[illegible]00 duty, 1119 1-2 tons coal.
At 58,000,000 " 1531 4-10 " "

Difference per year	420 9-10 tons at $8	$3367
Cost of 2 beam rotative engine	$135,000	
" 2 Duplex "	70,000	
Difference in first cost	$65,000	
15 per cent. on $65,000	9,75[illegible]	
Deduct annual saving on coal	3,367	
Amount saved annually by using Duplex engine		$6383

To this saving I do not attempt to add anything for reduced size and cost of buildings. It will be found no inconsiderable item. And allow me to say, in conclusion, that I do not concede, except for the purposes of this comparison, that the current yearly duties will differ as 53 to 80. The Duplex has already secured a yearly record at least equal to 58,000,000, made up on total coal consumed at the engine house for all purposes. But I have not yet seen a yearly duty of 80,000,000 calculated on that basis.

Respectfully,
HENRY R. WORTHINGTON.

Mining Law.

WE are in receipt of the following circular :

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., March 5, 1875.

The following is an Act of Congress approved February 11, 1875 :

AN ACT to amend section two thousand three hundred and twenty-four of the revised statutes, relating to the development of the mining resources of the United States.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section two thousand three hundred and twenty-four of the revised statutes be, and the same is hereby, amended so that where a person or company has or may run a tunnel for the purposes of developing a lode or lodes, owned by said person or company, the money so expended in said tunnel shall be taken and considered as expended on said lode or lodes, whether located prior to or since the passage of said act ; and such person or company shall not be required to perform work on the surface of said lode or lodes in order to hold the same as required by said act.

By this legislation the requirements of section 2324 Revised Statutes (5th section of the Mining Act of May 10, 1872) in regard to the expenditure upon mining claims, are so modified that money which has been or may be expended in running a tunnel for the purpose of developing one or more lodes owned by such person or company, shall be considered as expended upon such lodes.

The expenditures required upon mining claims may be made from the surface or in running a tunnel for the development of such claims.

S. S. BURDETT, Commissioner.

NEW PUBLICATIONS.

GEOLOGICAL SURVEY OF CANADA.

The report of progress for 1873 4, of the Canadian Geological Survey, under the direction of A. R. C. SELWYN, F. R. S., gives gratifying evidence of the vitality of that great work. Explorations have been extended into the remote regions of the Northwest and upon the coast of the Pacific. The volume abounds in information important to the progress of geology, and of direct economical value. It contains, besides the report of the Director upon the general work of the Survey, his account of explorations northward from Fort Garry to the Rocky Mountains, a report on operations in Manitoba, with the diamond-pointed stream-drill, in search of coal ; explorations of the coal regions of British Columbia ; of the deposits of graphite and apatite of several counties ; of the explorations in the coal fields of Nova Scotia and Cape Breton; a chapter on the iron ores of Canada and their development, and notes on the geology of the country north and west of Lake Superior.

The Whale Lode, of Park County, Colorado Territory.

By JOSEPH L. JERNEGAN, JR., M. E.*

THE Whale Lode occurs in the main range of the Rocky Mountains, Park County, Colorado Territory, at the Hall Valley. It has been opened up and worked to some extent by the Whale Mine, situated some 11,300 feet above the level of the sea. The mine, with 700 feet of the lode on either side of the discovery shaft, is the property of the Hall Valley Silver-Lead Mining and Smelting Company.

The adjacent country rock is a compact, fine grained gneiss ; its general strike is about North and South, dipping steeply to the West. In the immediate vicinity of the mine, the strata are very nearly vertical. The gneiss incloses numberless veins of a reddish granite, in which the feldspar largely predominates over the quartz and mica, the latter oftentimes being scarcely perceptible. As a general rule, these granitic veins seem to more frequently follow the lines of stratification of the gneiss, than otherwise. They are of varying width, some large, some small ; the larger are from 5 to 6 feet wide. Gash veins of feldspar and quartz are also of very frequent occurrence.

The general trend of the lode is about northeast and southwest, intersecting the country rock at about an angle of 45° to its stratification. It dips to the North West at an angle of 65°. I am unable to accurately state how far this lode has been traced upon the surface, but it is at least well known to extend entirely through the mountain upon which the mine is situated, and is traceable over the ridge by a hollow extending for some distance along the surface, in which the lode crops out. This hollow in the surface rock has probably been formed through decomposition of the vein matter by atmospherical influences. The width of the crevice is variable, generally between 5 and 10 feet ; the pay-vein varies from an inch, or less, to 36 inches. The vein is generally accompanied both on foot and hanging walls, by a whitish, semi-decomposed rock, composed of quartz and decomposed feldspar, and in some places—where the process of decomposition has not reached as advanced a stage—a light greenish, or black, mica. This rock, therefore, is in places composed of all the constituents of gneiss, and is undoubtedly nothing more or less than the same in a decomposed condition. It is often very strongly impregnated with iron pyrites, generally crystallized in minute cubes, and it is probably owing to the presence of this mineral that the rock is in such a state of decomposition. The vein is frequently separated from this decomposed country rock by a "gouge" of clayey substance.

* A paper read before the American Institute of Mining Engineers, at the New Haven meeting, February, 1875.

The accompanying sketch will serve to give the reader a more lucid idea of the general structure of the lode.

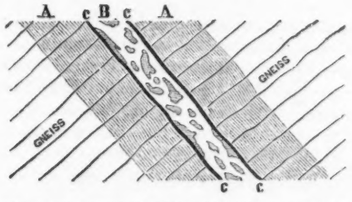

Fig. 1.—A. Decomposed gneiss impregnated with iron pyrites. B. Vein of barite inclosing irregular bunches of galena and gray copper. c, c. Clay "gouge."

The occurring minerals, including also those constituting the decomposed walls of the vein, are quartz, decomposed feldspar, mica, *clay*, barite, dolomite (brown spar), iron pyrites, galena, gray copper (tetrahedrite), copper pyrites, malachite, azurite and sulphate of copper.

The feldspar and mica are confined to the decomposed wall rocks. Quartz occurs both in the wall rocks and the ore vein. Iron pyrites seems to be almost entirely confined to the decomposed wall rocks, mere traces, if any, occurring in the ore vein. Barite, brown spar, galena, and gray copper pyrites, are present only in the ore vein. The clay constitutes the "gouge" on either side of the ore vein. The minerals of secondary formation, malachite, azurite and sulphate of copper, are also confined to the ore vein, and occur principally in portions of the lode not far from the surface.

Of the metalliferous minerals, galena and gray copper are of the most frequent occurrence. Barite is the principal and almost only gangue where the ore vein is of any considerable width; where pinched, however, quartz and brown spar are associated with it, the barite sometimes disappearing, especially if the vein carries no ore.

The entire, or almost entire, absence of iron pyrites in the ore vein is rather singular, especially as the decomposed gneiss on either side is frequently strongly impregnated with this mineral. This circumstance might be explained by impregnation from the vein outwards into the wall rocks, accompanied, perhaps, by deposition of other mineral in the space formerly occupied by the iron pyrites.

Crystallized occur: barite, quartz, brown spar, galena, tetrahedrite (seldom) and iron pyrites. The barite often in large tabular crystals; brown spar in small rhombohedrons; quartz in six-sided prisms, terminated with six-sided pyramids; galena in cubes modified by the octahedron; tetrahedrite in modified tetrahedrons, and iron pyrites in minute cubes in the decomposed wall rocks only. The crystals of quartz are oftentimes colored a reddish brown, or yellow, through the agency of oxide of iron, and the crystals of barite a pinkish color. The presence of oxide of iron is very general in the upper portions of the vein near the surface, imparting to the crevice matter and wall rocks a more or less reddish brown tint, thus forming a very distinct gossan, or "*iron hat*."

Of pseudomorphism, one instance only has come within my observation; it was copper pyrites after tetrahedrite.

The general structure of the vein is porphyritic; snowy white barite inclosing irregular lumps of galena and gray copper. The banded structure, however, is not uncommon for short distances, especially where the vein is pinched. The presence of the banded structure in this lode speaks in favor of its belonging to the class of true fissure veins, on which point, I think, there can be no doubt.

Fig. 2.

It has previously been intimated that the vein varies in width, being much wider in some places than in others, as represented in Fig. 2. Its porphyritic structure is shown in the wider parts, and the banded where it is pinched. This frequently recurring inequality in the width of the vein may be owing to a lateral movement of the fissure walls subsequent to the formation of the crevice. Smooth and polished slickensides are often observable, and their occurrence speaks somewhat in confirmation of the above view. Straited slickensides, however, from which the direction of the movement might possibly be deduced, have never come within my observation.

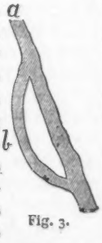

Fig. 3.

Heaves and slides are, up to the present time, unknown to the lode. The vein sometimes splits and incloses a fragment of the country rock, called by the miners a "horse." Spurs and stringers also occur. In drift No. 1. of the mine, 73 feet from the mouth and in the hanging wall, a spur, measuring about 24 inches in width, comes in at about an angle of 45° and joins the main vein. The course of its strike is about north and south, consequently parallel to the stratification of the country rock; its dip also coincides with the same, namely to the West. Its mineral character agrees with that of the main vein, the gangue consisting of barite; the metalliferous minerals are galena and gray copper. Thus far, I have not been able to trace this branch of the vein into the lower workings of the mine.

Some 235 feet from mouth of same drift, the vein throws off another spur at about an angle of 30° into the foot wall, dipping north 75° west, therefore opposite to dip of main vein. In drift No. 2., 50 feet vertical distance in a straight line beneath the same point in drift No. 1, the same spur can be perceived coming again into the main vein on the foot wall, it having a dip of about 25°, which would bring them together somewhere between the second and third levels. This spur or branch vein must consequently describe an arc of a circle, as represented in fig. 3., which is an ideal cross section; *a*. main vein, *b*. branch vein. Whether, in driving the first and second levels further to the southwest on the line of the main vein, this branch vein will again come in and join the vein, remains to be seen.

As regards the distribution of metalliferous mineral within the vein, it seems to be more or less influenced by the nature of the country rock, gangue and width of crevice. Where the crevice is wide, the gangue consists almost entirely of crystalline barite; the adjoining country rock is mild and decomposed and at the same time strongly impregnated with iron pyrites and the metalliferous minerals seem to be present in much greater proportion. Where the vein is pinched, the wall rocks are unconformable, hard, and of a less decomposed nature, a light greenish or black mica forming one of its principal constituents, deficient in iron pyrites, and at the same time contain numerous little stringers of a grayish quartz. The gray copper oftentimes seems to be present in proportionately larger quantities in the narrower parts of the vein; or, more strictly speaking, the relative proportion of gray copper to galena is greater than in the wider portions of the vein. Where barite occurs in large crystals, the metalliferous minerals are more scattered and less frequent. Where the vein throws off spurs, or divides, in taking in a "horse," it is almost always poorer. It is probable that in further exploitation, the ore will be found to be chiefly confined to zones, or chimneys, as already the first, second and third levels have been drifted through considerable ground on the vein that has proved quite barren of ore, though the crevice has always remained well defined.

The most striking characteristic of this lode is a crevice almost entirely filled with the mineral barite, carrying argentiferous galena and gray copper. The preponderance of barite over all the other minerals of the vein is of great significance in regard to the dressing and subsequent metallurgical treatment of the ore.

The Whale Lode might perhaps be well compared to the so-called barytic-lead formation of Freiberg in Saxony, of which the principal minerals are barite, fluorite, quartz, galena and zincblende. Common to both are barite, quartz and galena.

The geological history of this lode seems to have been simple, and somewhat as follows: 1. Formation of the fissure in the country rock by means of plutonic agency, and, perhaps, accompanied at the same time by a lateral movement of one or both of the fissure walls. 2. Deposition from solution of minerals now composing the vein material on the sides of the fissure. A third period might perhaps be added, viz: The impregnation of the country rock from the vein outwards with iron pyrites.

The above might, of course, be extended into many more periods, were the effects of chemical changes to be taken into consideration. I do not wish to be understood by deposition of minerals now composing the vein, as assuming that the minerals were actually deposited from their solutions in the very form and state of chemical composition in which they are at present found; it is by far more probable that many and various chemical changes have taken place since the time of their first crystallization upon the sides of the crevice.

There are numerous other veins in the vicinity of the Whale Lode, which have been more or less developed, and almost all of them are similar to the "Whale" in many of their characteristics, especially in the frequent occurrence of barite, which is, to say the least, worthy of notice.

The Semi-Bituminous Coal Regions.

BY ANDREW ROY.

BETWEEN the Anthracite deposits of Pennsylvania and the North-western terminus of the trunk of the great coal field, there exists a series of small but most important basins, which, like the anthracite basins, are the detached fragments of a once unbroken field. These basins extend from Tioga County in the North-Western part of Pennsylvania, in a south-westerly course to Hampshire County, in West Virginia. The coals are intermediate between anthracite and bituminous, and are highly prized for the generation of steam and for metallurgical purposes. These basins are called respectively the Blossburg Region, the Towanda Region, the McIntire or Ralston Region, the Philipsburg or Clearfield Region, the Johnstown Region, the Snow Shoe Region, the Broad Top Region and the Cumberland or Frostburg Region.

The Blossburg, Ralston, and Towanda regions are an assemblage of small deposits lying high in the hills, and are the most northerly of the series. The Blossburg mines have been in operation for 35 years, the first coal mined and shipped to market having occurred as early as 1840. The Fallbrook Coal Company, the Morris Run Coal Company, and the Blossburg Coal Company, are the principal operators of the Blossburg Region. There are 5 different seams of workable coal, the measures aggregating 350 feet of thickness, corresponding to the lower coal measures of the grand trunk; only three of the seams are at present mined. The principal bed is the Bloss vein, which ranges from 4½ to 5½ feet in thickness. The mines are generally level, free, and have a fine roof, admitting of wide and tasteful workings. The Towanda basin, which is the second of the series, is on the summit of Towanda Mountain, 2000 feet above the level of the ocean, and the counterpart of the Blossburg field. The Snow Shoe basin is a small deposit, about 8 miles long by 4 wide, situated on the head waters of Beach Creek in Center County. The Clearfield Region, in the line of the two

counties of Center and Clearfield; although only opened up since 1870, has already become a region of vast importance. Sixteen different companies are now operating in this basin, and last year, 639,630 tons of coal were shipped from the mines to the Eastern coal markets. The principal bed of coal is about 5 feet thick, of remarkable purity. There are several other seams of a workable height, but they are subject to sudden variations, both as regards thickness and quality of mineral.

The Johnstown region is situated in Cambria County, 78 miles east of the city of Pittsburgh. The coal of this field is mainly used at home, in the manufacture of iron, valuable deposits of iron ore and limestone being found associated with the coal strata.

The Broad Top coal field is found in parts of three counties, Bedford, Huntingdon and Fulton. This field resembles a great platform, and occupies eighty square miles of area. The coal measures are fully 900 feet in thickness, and inclose several seams of workable coal. On the highest top of the Broad Top Mountain a few acres of the Pittsburgh coal appear.

The largest and most important of the semi-bituminous coal fields of the series is that of the Cumberland or Frostburg basin, situated in Western Maryland. It is bounded by Dan's Mountain on the East, and Savage Mountain on the West, and extends from the Pennsylvania State line to West Virginia. Its greatest length is about thirty miles, and its average breadth about four. It has been subjected to excessive erosion, which has cut down through the heart of the coal measures for nearly one thousand feet, carrying away a large and valuable portion of coal.

The main seam of coal, called the Big Vein, the equivalent of the Pittsburgh, is from 8 to 14 feet in height and is of magnificent quality at all points of the field. Along George's Creek, the coal is high up in the mountains and is moved in the mine cars to the railroad by steep inclined planes. The town of Frostburg, which is 1100 feet higher than Cumberland, 10 miles East, is built on a transverse ridge which connects Dan's Mountain and Mount Savage. A little south of this place, the basin attains its greatest width, reaching nearly seven miles, and encloses all the seams of the series. In the center of the basin, along the ridge, the great seam has to be sunk for by shaft mining. Northeast of Frostburg, the deep erosion through which Jennings River flows admits of drift mining.

On the northwestern points of the basin, the great vein is not more than 8 feet in height, but southeast, along the line of direction of the coalfield, it gradually thickens, till on reaching the other limit of the seam, it attains to 14 feet. Only in one or two mines is the whole thickness of the seam removed in mining. The roof is in general a brittle shale, which cannot be maintained with prop-wood and about two feet of coal is left standing. Along George's Creek, in addition to the roof coal, between 3 and 4 feet of bottom coal is left without any attempt at mining, and as this coal is of equal purity to that mined, it is a matter of wonder that it is left in the mine. The whole thickness of the bed will yield on an average 17,000 tons of coal to the acre, but with the present wasteful modes of mining, not more than 7,000 tons are realized.

Work Done with Burleigh Drills.

SINCE the introduction of the Burleigh drill and air compressing machinery on this coast, about two years ago, it has accomplished feats which were deemed impossible. In tunneling work especially it has been of immense advantage, and has enabled mining companies using it to do double the work at a great reduction of expenses. Of late it is being used extensively in the gravel mines, where a great amount of tunnel work is often necessary. The Burleigh drill is in use at the Golden Star mine, and has given great satisfaction. We append a letter from the Secretary of this company to the agents of the drill in this city, which, as it gives details of cost and work accomplished, is of interest to the mining community :

OFFICE OF GOLDEN STAR M. Co., Sacramento, March 8, 1875.

MESSRS. PARKE & LACY—*Agents Burleigh Drill Machinery*—GENTLEMEN : For the information of those engaged in mining, and who may be contemplating the purchase of your machinery, the directors of our company have instructed me to state that the drill, with necessary propelling power and connections, was placed in our mine and commenced work about the 1st of December last. The material is hard cement with cobble intermingled, and, working with the ordinary hand drill, three shifts would make about two feet per day, costing us from $12 to $15 per foot to run the tunnel, which is 7×7. With this machinery, we make from five to six feet per day—at a cost of from $6 to $7 per foot.

During the three months' or more use of the machinery there have been no breakages or repairs worth mentioning.

Annexed is a report of the actual working of the drill for the 22 days comprising the month of February. It is deemed proper to add that the cost of the machinery complete, set up and at work at our mine has been $4,500, and this includes column, drills, extra parts, 2000 feet of ten inch iron pipe, asphaltum coated, air tanks, air compressor and 15 horse-power boiler—original purchase money and placing and housing the machinery.

Report of working Burleigh drill machinery for 22 working days of February, 1875, at Golden State tunnel, Sierra County, Cal.

Size of Tunnel	7×7
No. of one and three-fourth inch holes drilled	698
Aggregate length of holes	2443 feet
Average depth of hole	3 feet 6 inches
Consumption of wood per day	¾ cord
Steam and air pressure	75 pound

Lubricants—43 gallons oil ; 10 lb. tallow ; one lb. black lead. No repairs.

The entire expenses for the month cannot vary much from $700 or about $6 per foot for the tunnel actually made.

Given under the seal of said company, by order of the Trustees.

LAUREN E. CRANE, Secretary.—*Exchange.*

Separation of Gray Copper Ore, or Fahlerz, from Barytes.

BY FRIEDRICH STURM.

THE fahlerz obtained at the Kogler mines is found in the limestone formation, and is, for the greater part, accompanied by barytes (heavy spar) which occurs in pockets and nodules, but mostly in widely diverging threads. The slight difference in specific gravity of these two minerals, fahlerz being 4·5 to 4.85, barytes 4·3 to 4.7, renders their separation impossible by the wet way on sieves and buddles. Heretofore the numerous experiments conducted for years, and at much expense, to effect a mechanical separation of the ores have failed.

When different kinds of barytes, especially the crystallized and crystalline varieties, are heated before the blow pipe, they decrepitate and crumble up into a powder, which consists of small rhombic plates. This led me to think that this property of barytes could be employed for its separation from the fahlerz, which is able to resist a moderate heat.

The first experiments, undertaken with small quantities of ore and incomplete apparatus, led me to hope for favorable results from this method of separation, hence I undertook the following more accurate experiments with larger quantities of the ore. The ore experimented upon contained from 75 to 80 per cent. barytes, and was sorted according to the size of the lumps, from 3 to 5 mm. (1-10 to 2-10 inches), and placed in covered cast iron pans, where it was calcined with occasional stirring until the decrepitation had nearly ceased. It was then passed through a sieve along with pieces of fahlerz and some pieces of lime which had not been entirely removed in its preparation for the experiment. Some of the finer pieces of fahlerz had broken off and gone through the sieve with the barytes, and hence the latter was passed through two more sieves, one with meshes 1 mm. wide and the other with ½ mm. meshes. Fahlerz sand constitutes the residue. Thus three end products were obtained (lumps of fahlerz, fahlerz sand and barytes powder.) The table shows the results of my experiments. The 10 per cent. of loss is attributable to loss of moisture, spattering of the barytes and what goes off as dust. The time required depends on the firmness and on the size of the lumps. In the experiment above described a hundredweight required 40 minutes, so that 18 charges could be worked in 12 hours.

	Pounds.	Metal in Cwt.—Silver Mint Pounds.	Metal in Cwt.—Copper Pounds.
Ore taken for experiment	100	0.045–0.048	4 to 5½
Obtained from this :			
Lumps of fahlerz	20–22	0.248–0.254	20–20½
Fahlerz sand	4– 8	0.018–0.080	2–7
Barytes powder	61–64	0.010	
Total average	90		

The results would be still more favorable if large quantities were operated upon in a flame furnace, arranged to be worked continuously, and with improved contrivances for separating and sifting. The advantages of the method are briefly these : 1. Simplicity and rapidity of the process combined with almost perfect separation. 2. Small expense. 3. Large amount of metal obtained. 4. Poorer ores can be profitably employed.

The author will continue his experiments on concentrating the fahlerz in the fine, sandy state.—*Journal of Applied Chemistry.*

Blasting Memoranda.

THE following table gives the space occupied by any given quantity of powder in round holes of different sizes, from one to six inches diameter :

Diameter of the hole.	Powder contained in one inch of the hole.	Powder contained in one foot of the hole.	Depth of hole to contain 1 lb. of powder.
	oz.	lb. oz.	Inches.
1	0.4	5.0	38.19
1½	0.9	11.3	17.98
2	1 7	1 4.1	9.55
2½	2.6	1 15.4	6.11
3	3.8	2 13.2	4.24
3½	5.1	3 13 6	3.12
4	6.7	5 0.4	2.39
4½	8.5	6 5.8	1.89
5	10.5	7 13.7	1.53

The rule for calculating the amount of powder for a given weight is that "*the charges are proportional to the cubes of the lines of least resistance,*" that is, if from experiment we find that in a certain rock 4 ounces of powder is sufficient to blow out a hole where the depth of the line of least resistance from the bottom of the hole to the surface is 2 feet, then for one where this depth is 8 feet the charge would bear the same proportion to 4 ounces as 2^3 does to 8^3, that is, 64 times; it would consequently be 16 pounds. The following table is calculated in this manner, and is for the case of a moderately hard rock, such as certain kinds of limestone :

Line of least resistance.	Charges of powder.	Line of least resistance.	Charges of powder.
	lb. oz.		lb. oz.
1 foot	½	4 feet	2 0
1½ "	1.7	4½ "	2 9
2 "	4.0	5 "	3 15
2½ "	6.25	6 "	6 12
3 "	7.8	7 "	10 12
3½ "	1 5.0	8 "	16 0

The World's Production and Consumption of Quicksilver.—The San Francisco *Commercial Herald* of March 25, in an article on Quicksilver says: "We have now a dozen or more productive mines in this State, most of them have separate agencies in this city for its sale; of course most of the parties are anxious or obliged to sell as fast as received, and from present appearances, prices are likely to drop below the rate of production, unless some unity of action be adopted for the protection of those most interested. It will be interesting to look a little into the matter, and see as to the World's production and its consumption. In 1874, the Almaden mine of Spain produced 30,000 flasks; Idria (Austria) 10,000 flasks; California, 40,000 flasks (estimated for 1875). Here we have a total production of 80,000 flasks. The local and New York consumption is estimated at 20 000 flasks; Mexico 12,000 do; China and India, 15,000 do; South and Central America, 6,000 do; England, France, Germany, etc., 30,000 do. Total, 81,000 flasks. Our monthly production is placed at 3,500 flasks; local consumption, 1,500 flasks, leaving some 2,000 flasks to be disposed of in some way, either by sale or shipment abroad. It has been publicly stated that the high prices ruling for the year past have greatly reduced the world's consumption, and that a very low price will produce the contrary effect. Those best qualified to know deny the assertion that the high price has materially diminished the consumption. On the contrary, it has resulted in using up all surplus stocks that had, for years past, been accumulating abroad. In December last, the price in London reached £25@26, but a cablegram now informs us that the price there has been reduced to £15. It will be noticed, from our estimate of the total production and consumption, that there is need for all that is being produced, but there is no sale for it here at present.

Discussion of the Report on Rapid Transit, made to the American Society of Civil Engineers, Feb. 3, 1875.

BY RICHARD H. BUEL.

NO ONE can read the report under consideration, without seeing that its preparation must have involved an immense amount of labor—labor, I am sorry to be obliged to add, which seems to me to have been applied by no means to the best advantage. I will endeavor to give my reasons for this opinion, as briefly as possible.

I.

The committee report that they have examined 75 distinct plans for rapid transit, and that a large part of their labor has consisted in this examination. In a circular issued by the committee, they invited plans from interested parties, promising to give due credit to all replies. It is reasonable to presume that many of the plans would not have been presented, had it not been for this assurance, and the supposed ability and fairness of the committee. We have only to turn to the report to see how the promise of the committee has been fulfilled. We will find a few features of some half dozen reports referred to, in terms of partial commendation, but the great majority are simply classified, the names of those who presented them not even being given. Some persons may infer from this, that the committee considered the generality of the plans to be so bad, that the most merciful way would be to say nothing about them. But, whatever the reason for the treatment may have been, I submit that the action of the committee is in direct contradiction to the assurances given in their circular, and unpardonable, when viewed in an engineering light. This committee, to some extent, represented a commission, that had invited plans for an engineering structure, reserving to themselves the right to reject all that was offered, and make their own plan, agreeing, however, to credit each bidder with everything in his proposition that was of value. I think that no one can read the resolution under which this committee was appointed, and the circular in which they called for designs, without acknowledging that this is a correct view of the case. It may be profitable, then, to compare the action of the committee with that of a commission who have charge of an engineering work, as, for instance, a bridge. It is pretty well known to all the gentlemen here present, that there are, in general, two ways of managing such a piece of business. In one case, a commission will advertise for a bridge to cross a certain stream, specifying neither location, span, rolling load, factor of safety, or any limiting detail—a course of action which usually prevents any competition from reputable firms, or results to their utter discomfiture by "tin pan" builders, in case one or two should be so inexperienced as to send representatives to the letting. In the second case, the commission, with a due regard for their responsibility, will proceed to draw up a specification, which, while not necessarily limiting the best design to one particular form, will serve as a standard, by which all plans that are presented can be judged—and by comparison with which, it will be easy to tell how good or how bad any particular design may be. This committee has chosen to act, not as an engineering commission usually proceeds, but more nearly after the manner in which ordinary highway commissioners treat technical details. It results from this, that they have invited plans under false pretences, and have not given due credit to those who presented them—for it is the right of each competitor to know, not only how good his own design may be, but exactly how it ranks in comparison with others. Speaking for myself, I can freely say that I esteem it no honor to be told by this committee that the plan presented by the Messrs. BUEL is the best that has been received, while most of the other plans were apparently so bad that they were not even noticed—and I may add that the paper in question would not have been submitted to the committee, unless it had been supposed that it would have received their thoughtful consideration. Good or bad, I think no one can read that paper without admitting that it is a carefully prepared engineering statement, and, unless I am greatly mistaken, it is the first paper upon the subject, in which the details of the question have been considered of more importance than the specific plan. For so much, I feel that the writers should have received credit, and I consider further, that in presenting an engineering paper to a committee of engineers, they were entitled to be told whether the questions there proposed, which were certainly fair and important questions, were or were not answered in a proper manner. In addition, I have to complain of inaccuracy on the part of the committee, even in their brief reference to the paper of the Messrs. BUEL. Thus, the report of the committee states that the elevated way proposed by the Messrs. BUEL is estimated to cost $450,000 per mile, and that it is proportioned for a rolling load of 1500 lb. per foot of track. The elevated way in question is, in fact, proportioned for a load of 3000 lb. per foot of track, and is plainly so specified. This is a misstatement which, being published wide-spread, does the Messrs. BUEL gross injustice—laying them open to the charge of having designed a flimsy structure, disproportionately light in comparison with its cost.

While naturally giving more consideration to the action of the committee as affecting myself, I do not lose sight of the fact, that every other person who presented a plan, was entitled to have it judged by a standard—and inasmuch as the committee neglected this act of simple justice, they have failed in their duty as engineers.

The paper presented by the Messrs. BUEL contains a statement to the effect that it furnishes a standard, by which the relative merit of other designs can readily be estimated. In illustration of this statement, the writers have prepared a synopsis of all the plans submitted to the committee that were found in the library of the Society, after the committee had been discharged. I present this synopsis to your consideration, in the belief that it will be of service to future investigators, while, at the same time, it will be found corroborative of the arguments which I am about to introduce.

II.

The points upon which this committee lay most stress, and to which they have devoted a large part of their report, are—will a rapid transit road pay—and how much can be spent upon its construction and equipment. From the nature of the case, these are just the subjects which can only be settled by experiment. All that can be demonstrated by the most careful calculation, is, that if a given road gets a certain amount of patronage, it will pay a definite profit; but it seems to be trifling with the subject, to make an assumption, which may or may not be true, and then, after an elaborate calculation, arrive at a result which is deemed of sufficient importance to be made one of the final conclusions of the report. This is a method commonly employed by young engineers, with plenty of book learning and little practical knowledge—but it does not look well, when coming from a committee of gentlemen experienced in the profession. If I have rightly read the able papers by a member of this committee, on rails and car wheels, it is the requirements of the case that determine how much can be spent upon these details, and I am somewhat at a loss to understand why this kind of treatment is not good for rapid transit, as well. It is rather anomalous, also, to state that a tunnel can possibly be constructed in the 4th Avenue, and not in any other street; but, examining the steps by which this conclusion was reached, it appears that this is only possible, in case the 4th Avenue Improvement, or so much as is needed, is given to a rapid transit company, while, if the company is obliged to pay for the use of this part of the road, no more can be expended on construction in the 4th Avenue than in any other part of the city. This is trifling with the subject. It is quite true, as remarked by the committee in treating of this matter (report, p. 9), that "a paying road, receiving new business from any source, can afford to do it at but little more than the increased cost occasioned thereby." This condition, however, does not apply to the 4th Avenue Improvement, considered in connection with rapid transit—because, if it is used for that purpose, rapid transit will monopolize at least two of the tracks, to the exclusion of other business, and the cost to the rapid transit company using these tracks will be just the same as if the same method of construction were employed upon some other part of the route.

On page 4 of the report, the committee speak of two independent calculations in regard to train expenses and possible revenues, and say that the close agreement of the results "was gratifying." A comparison of the independent calculations, in two cases that are approximately alike, will show a difference in the estimates of the cost of running trains, of about 25 *per cent.*, and, as the train mileage for an annual business of 60,000,000 passengers is some 5,000,000 miles, it appears that the difference in operating expenses, calculated by the two methods, is about $500,000. This is, indeed, "gratifying!"

III.

Instead of meeting the difficult questions of the rapid transit problem fairly and squarely, this committee has chosen either to dodge them, or to treat them in such a non-committal manner, as to leave them entirely unsettled, so far as the report is concerned. I will endeavor to make this statement good, by citing several instances.

(*a.*) ACCESSIBILITY.

In regard to accessibility, the committee say that the system should be arranged so that a rapid transit road shall be able to do not only the business of the street in which it is located, but shall also gather patronage from other parts of the city. Having said so much, they dismiss the question, merely remarking that the Messrs. BUEL have proposed a plan, which, however, they decline to characterize as either good or bad. I ask, gentlemen, is this a proper way for engineers to treat a question of such importance, and is this giving due credit to plans presented? The system of cross-town surface lines, described by the Messrs. BUEL, was laid before this committee with carefully elaborated arguments, is, at least, drawn up in technical language, and is, so far as I know, entirely novel. Its aim is to render it possible, with a few main lines of railway, for persons living at a distance from any of these main lines, to travel about as conveniently and

cheaply as those whose residences are directly contiguous, and it provides for travel in every direction, longitudinally and transversely. Its aim is, further, to aid in the solution of the question of a real estate owner "What is rapid transit worth to me?", since it is obvious that rapid transit is much more valuable for a citizen to whom it is convenient, than for one to whom it is remote. Its aim is, finally, to make it possible to effect all the transportation of passengers on two main lines of railway, so long as the amount of travel is within their capacity. Now it may be that the system proposed by the Messrs. BUEL fails completely of accomplishing all these objects—but probably no one will deny that its aims are important. The committee have presented no substitute, and have paid no attention to the carefully prepared arguments of the Messrs. BUEL. This is an easy way to evade a difficult question, but I submit that it reflects little credit upon the committee, or upon this portion of their report.

(*b.*) WEIGHT OF CARS AND LOCOMOTIVES.

A quantity of interesting and valuable data is given in the report, for the purpose of showing, that, while on an ordinary surface road, the weight per passenger of cars and locomotive is 1,034 lb., on an elevated road it can be reduced to 457 lb. The reasons for this are not, however, so obvious. It appears from the report, that heavy cars require more power to stop and start them, and hence are subjected to greater strains, consequently they must be made stronger and heavier. As I read this elaborate argument, which may be found on p. 22 of the report, it seems to me to express simply that heavier cars must be stronger, because they are heavier—but I find no argument to prove that they should be heavier because they are on surface roads. In other words, if cars on an elevated road are to be run at the same speed as on a surface road, if they are to be stopped and started as quickly, and are to be constructed with the same factor of safety, it is difficult to see why what is good for one road will not be equally good for the other. The committee had an opportunity, at this point, for doing some exceedingly valuable work, but they preferred to proceed by assumptions, which hardly add to the value of the report, or advance the subject under consideration.

(*c.*) LENGTH OF TRAINS.

The committee would have rendered good service to the cause of rapid transit, if they had enlarged a little upon the statement in foot-note (*c*), p. 7, that "The road must be operated by the most approved system of block signals," to tell us how many trains per hour could be safely run upon a single track. Some data would then have been available for determining whether a maximum train of 3 cars, as proposed by the committee, was better than one of 4, 5, 6 or more; in other words, if they had defined the conditions limiting the length of a train. It may be that a train of 3 cars is the best, all things considered, but if so, there must be a reason. It is true that, with such a small train, the rolling load is diminished, and a cheaper structure is the result. It is equally true that the builders of the Croton Aqueduct would have furnished it to the city at less first cost, if they had only made it half so large. If there is no general principle, save that of economy in first cost, governing the construction and operation of a rapid transit road, it might be well to figure on the basis of a single car, with dummy engine within itself. It is probable, however, that there are some other considerations affecting this part of the question, which the committee skilfully avoided by the use of an assumption, instead of reasoning the matter out.

(*d.*) TERMINI OF A RAPID TRANSIT ROAD.

In further illustration of the lack of decision evinced by the committee, it may be remarked that the report does not fix the lower terminus of rapid transit at all, some of the estimates being based upon roads starting from the Battery, others from the vicinity of the City Hall, while the locations of upper termini are equally vague and conflicting.

(*e.*) RATES OF FARE.

The committee have not given any arguments in favor of particular rates of fare—their estimates being made for high as well as for low fares, so that the report contains nothing upon this subject, that is calculated to place it at rest, it being left an open question, so far as the committee have treated it.

(*f.*) DEPOTS.

The committee have almost entirely avoided mention of the principles to govern the construction of depots. If there are none this would have been a good point for the committee to have made.

(*g.*) METHODS OF CONSTRUCTION.

The committee do not prove that underground methods of construction, or railways in new avenues to be opened for their use, would not be remunerative, if they commanded patronage in proportion to their capacity, with rates of fare and means of accessibility conducive to this end; but they are content to assume that, because their cost is great, it is necessarily prohibitory. This is an evident fallacy, and it is an excellent illustration of the danger of reasoning from assumptions. The committee make a few assumptions which may or may not be true, for any proof that is given, and deduce therefrom that the cost of anything but an elevated way is probibitory. This may be ingenious, but it is neither commendable nor conclusive.

(*h.*) CHARACTER OF THE ELEVATED WAY.

The committee do not lay down any general principles to govern the construction of elevated railways (which they recommend, but do not prove to be the only practicable form of structure), other than to suggest spans of about 50 feet, when the support is taken in the roadway, and to arbitrarily define that the rolling load should be assumed at 1,200 lb. per foot of track, without even considering the proposition that a more liberal proportion of parts may be more economical, in prolonging the life of the structure. The experience of engineers with railways composed entirely of bridges, over which a great number of trains are run, at high rates of speed, has not been so extensive as to warrant the reception of a rolling load of 1,200 lb. as an axiom.

As to whether the supports of the elevated way should be taken upon the curb line or in the roadway in the wide avenues, which comprise the greatest part of the route, the committee deliberately dodge the question, and gravely say that it may be one or it may be the other—an opinion worthy even of that grave philosopher, Captain BUNSBY.

(*i.*) LOCOMOTIVES.

The committee recommend for rapid transit a locomotive without truck or leading wheels. Possibly this may be all right, but it does not agree with ordinary American practice, in any case where considerable speed is employed, and is notably in opposition to the teachings of a recent valuable treatise upon the locomotive engine by Mr. M. N. FORNEY. It might have been well, therefore, for them to have given some reasons for their assumption. It is to be observed that they recommend increasing the adhesion of a locomotive, by adding more driving wheels, and thus maintaining the weight per foot constant. There is some prejudice on the part of railroad men to this practice, many of them thinking that a considerably weight is necessary in order that the wheels may "bite" properly. Hence it scarcely seems proper for the committee to assume that they can use this form of construction without giving reasons for their assumption. The committee, in treating this subject, assume that a locomotive is the only practicable form of motor. Several plans were presented to them, one, at least, in considerable detail, for operating trains with fixed engines. It may be that this system is all wrong, but if so, it would have been well for the committee to have settled the matter definitely, by giving some conclusive reasons. I have recently seen a paper by an able engineer, a member of this Society, advocating the plan referred to above, so that it may not be unreasonable to ask if the committee were justified in crediting this plan by omitting all reference to it.

(*j.*) LOCATION OF LINES.

The committee do not seem to recognize that it is possible that the average speed of trains, intervals between the same, means of accessibility employed, and capacity required, determine the location of the lines, but have apparently taken the easier course of assuming that the problem of location is purely a matter of taste. In their circular soliciting information they particularly desired respondents to be explicit in each case, as to "the route and location proposed, and the *reasons* therefor." The committee, while ignoring all suggestions, made in accordance with this invitation, have failed themselves to recognise the requirement which they laid down for others, of submitting reasons.

(*k*). RECOGNITION OF EXISTING INTERESTS.

The recognition of existing interests is treated by the committee in a manner that seems far from satisfactory. They propose to furnish a system of transit more rapid, more comfortable, and about as cheap, as the street car system, and to run it so as to supplement, not in opposition to, that system. They propose, moreover, in general terms, to give the people comfortable transit, in return for the concessions they must make to a rapid transit company. They recognize the necessity of securing accessibility, even if they do not hint at the method to be employed—and then they propose to run the new lines in connection with the street railways. It seems to me that this is something like the case of two parallel railway lines, one running parlor cars at a high rate of speed, the other, emigrant cars at a low rate of speed, the fare on each train to be the same, and then considering the interests of the two lines to be identical. It will be observed that the committee simply advance these propositions, without making any attempt to prove them. It may be added, in this connection, that the Messrs. BUEL have presented some arguments on this subject, by which they reach an exactly opposite conclusion—a showing being made, that a system of transit accessible to such number of persons as will relieve the indecent crowding of the present lines of travel, (which is possibly the primary object of rapid transit) will necessarily prove so expensive that it cannot subsist upon this diversion alone, but must further draw upon existing lines for an amount of patronage which will either render some of the latter unremunerative, or involve a greater increase in the volume of travel than seems probable. Now, of course, these arguments and conclusions may be worthless, but they were presented for the purpose of inviting criticism. The committee, however, completely ignore the arguments, which seems, in general, to be the way in which they have given credit for suggestions, and present some assumptions of their own, without any attempt to prove them. As before remarked, this is an easy way of treating a difficult question, but it does not give very valuable results.

(*l.*) COMPLETENESS OF THE SYSTEM.

In spite of the general remarks in the report, in regard to the necessity of a system that shall relieve the present crowded condition of travel, it will be found that the most comprehensive estimate furnished by the committee is that of two lines of railway each capable of transporting 30,000,000 passengers per annum. Now it is just possible that if such roads were to be operated in the manner permitted by the estimate, without any means of accessibility to parts of the city to which they are not immediately contiguous, and were to command their estimated patronage, they would bankrupt the street railways adjacent to them. If, on the other hand, the annual patronge of 60,000,000 passengers could be drawn *pro rata* from all existing lines, it would seem as if the construction account and operating expenses must be increased by the cost of the means of accessibility

by which this end is accomplished. In either case, it is difficult to see how the over-crowding of existing lines would be prevented, because the diversion of 60,000,000 passengers from the aggregate annual travel would still leave some lines crowded. While the committee are so far considerate of the comfort of the 60,000,000 passengers for whom their proposed system provides, as to recommend that half fare only be exacted of such as are not furnished with seats upon demand, their philanthrophy does not extend to the 90,000,000 passengers who must still continue to use the old system. Indeed, this philanthropy does not seem to be of such a comprehensive character as to enable the committee to see that an adequate system of transit should possibly be accessible to, and available for the use of, every citizen, so that his use of existing lines of travel would be a matter of option, not of obligation.

(*m.*) RECOMMENDATIONS MADE.

One will look in vain, in this report, for recommendations fixing the speed of trains, the gradients and degrees of curvature that will be necessary, or the details of operation. Taken as a whole, the report seems chiefly remarkable for what it does not establish, and in justice to the committee it should be stated that they have recommended, in decided terms, a gauge of 4'-8½" for the tracks, that the depots be placed upon summit levels, and be approximately as long as the trains, and that the rolling stock be provided with the most approved safety appliances. I search the report in vain for evidence that any other matter of detail is more definitely settled by this committees' treatment than it was before—so that the report is more likely to aggravate than to allay the confusion which exists in the public mind, as to the technicalities of rapid transit.

(*n.*) BUILDING A RAPID TRANSIT ROAD.

When an engineering structure of any kind is to be erected, especially when it is one affecting various interests, it is ordinarily considered advisable to draw up a complete specification, limiting the construction in every detail, and arranged with a due regard to the rights of the public and the company. The committee seem to think that it is impossible to do this in the case of rapid transit, and so recommend that the subject be referred to a commission, who shall settle the various details from time to time, as the work proceeds. In other words, they say that there are numerous questions that cannot be decided in advance. They speak vaguely of the varying character of structure required—of tunnels in some places; of going through the blocks in others, and in some localities, of making surface roads—but they have neglected to notice these modifications in their estimates of cost of construction. It would be of interest to see the location of some of these tunnels, for instance—and still more interesting to see a few reasons for this sweeping proposition of the committee. Here is an assumption that the construction of a rapid transit road comprises some novel features that have never before been met with in engineering experience, and that can consequently only be solved by actual practice; and that, further, the problem is so complicated that it is impossible for an engineer to consider in advance all the questions that may arise. This is certainly highly important if true; but, so far as this report is concerned, it rests upon the simple assertion of the committee. I question very much whether the gentlemen here present will agree with this assertion. If it is not possible, after a careful survey by an able engineer, aided by opinions from skilful lawyers and experts, to draw up a complete plan for rapid transit, and specify it fully in every detail, what becomes of engineering considered as a science? If there are details that cannot be specified in advance, how do you know it, and what is their nature? It seems probable that rapid transit will languish until such a survey is made, unless this question is to be presented to the consideration of capitalists in an entirely different manner from any other. The plan proposed by the committee, to draw a charter in general terms (exceedingly general, so far as their report establishes anything), and work out its details by the aid of a commission is by no means novel. It has been tried, in effect, for a number of years with anything but flattering success. It is the way in which most of the charters have previously been granted, and we have seen that capitalists will not touch schemes drawn in so loose a manner. Now I think the majority of engineers will bear me out in the statement that the most successful way to put a plan upon the market is first to make such surveys and collect such data that a complete design can be presented to the capitalist to show him what he is going to get for his money, or in other words, to answer the question proposed by Mr. DRAKE, "What is rapid transit worth?" Hence it seems to me that the action of this committee, in ignoring the treatment which experience has shown to be wise, and recommending that which has hitherto proved to be unprofitable, will tend to retard rather than to advance the solution of the problem of rapid transit.

IV.

It will be obvious to those who have followed me thus far, that I have pursued this discussion with some personal feeling—indeed, I could hardly do otherwise under the circumstances, but I hope I have also succeeded in showing that my objections to this committee's report have been based on broader grounds than mere personal considerations. I am ready to admit that all the conclusions reached in the paper prepared by the Messrs. BUEL may have been erroneous, but the questions proposed in that paper were fair questions, and I leave to engineers to compare the two methods of treating a subject, viz.: to avoid assumptions, as far as possible, and reason, from the best data at command, to conclusions, or to start out with vague assumptions, and so reach final results. In so far as I have been obliged to contrast these two methods in discussing the subject, my remarks have necessarily been somewhat of a personal nature, but I am willing to accept the judgment of engineers in regard to the relative value of the two methods of treating a technical question. There is one other point to which I wish to call attention in this connection, even though its introduction savor somewhat of egotism. A comparison of the report of this committee with the paper presented by the Messrs. BUEL will show that there is scarcely a single detail mentioned in the report, that is not also noted in the paper. Beyond this, however, the comparison does not hold good. In the paper, the writers have definitely settled each detail, as it was considered; wrongly, perhaps, but giving reasons for the decision in each case. Having done so much, they estimate the cost of building and operating a system designed in accordance with these details, and show what patronage it must secure in order to pay a definite profit upon the investment. In the report, however, the committee start out with the question "Will a rapid transit road pay?", settle scarcely any of the details of such a road, make some elaborate calculations by the aid of a few general assumptions, and finally conclude that a definite amount of expense can be incurred for construction. The radical difference in the manner in which the same questions are treated in the report and in the paper, suggests an unmistakable issue—which treatment is the most correct, considered from an engineering point of view? The facts of the case cannot be denied. The subjects treated in the report and in the paper are nearly identical; but the treatment given in the one case is, almost without exception, directly opposed to that given in the other. Now it is scarcely possible that both methods are correct, and unless the plan pursued by the committee is the most technical, professional and scientific, and that followed by the Messrs. BUEL does not represent good engineering practice—it seems just possible that some injustice may have been done by this committee to the writers of the paper. I submit to gentlemen here present that, from my standpoint at least, I am justified in pursuing this discussion with some personal feeling. I beg leave, also, to suggest the question, whether, in case the position of the committee is not impregnable, it is not due to the writers of this paper, that the Society should have it published, and should give it the discussion which was denied by the committee? It seems possible that this is not a question of particular designs, so much as it is of methods of investigating engineering subjects.

V.

A few words, in conclusion, in regard to the relation of the Society to this report, may not be out of place. You may preface a report by as extended a notice as you please, to the effect that the Society, as a body, is not responsible for the opinions therein contained—but you well know that it is considered by the public to be something with which the Society is intimately connected. This is so obvious, that I need not enlarge upon it. It is a necessary consequence of committee work in a Society. Now if the members consider that this report reflects credit upon them and the Society, they have only to discuss the matter, without taking any special action—and it will be commonly believed that this report is the best treatise on Rapid Transit that the American Society of Civil Engineers can produce. But if there be any who think that the report is far from representing the feeling of the Society, is far from being a credit to engineering skill, they will probably be inclined to say so in an official manner, in order that the public may discriminate between the committee's opinions, and those of the Society. Whether there is any feeling of this sort among the members present, enough even to enable me to obtain a second to the resolution I am about to present, I do not know. But in my opinion, it is advisable that some such resolution should be considered by the Society, and it may possibly aid in limiting the discussion to the salient features of the report.

I have another reason for presenting this resolution. The report of the committee has been accepted, the committee has been discharged, and the report has been officially characterized as "admirable." If you believe what I have said to be totally unfounded, you cannot, of course, be expected to reverse your former verdict. But, supposing only a small proportion of my statements to be established, it may be well to consider whether it will advance the interests and standing of the Society, to allow this report to remain on record, classed by official action as "admirable"—"admirable," for the methods of investigation employed; "admirable," for the reasoning that is omitted, and the assumptions that are substituted for reasons; "admirable," for the number of details which it mentions, and does not settle; "admirable," for the confused and unsettled condition in which it leaves the problem of rapid transit; "admirable," in particular, for the recommendation that no attempt be made to clear up this confusion in advance, but that difficult questions be left to a commission, to be settled, after the work begins.

If all these things are indeed "admirable," my resolution should induce you to reiterate the fact in a more emphatic manner than before.

Resolved, That the American Society of Civil Engineers, while recognizing the great care and labor that the Committee on Rapid Transit have employed in preparing their report, consider that it has grave defects and omissions, which detract greatly from its value;—and that those defects and omissions are a consequence of the improper treatment of the subject, by passing from assumptions to conclusions, rather than by reasoning from observed data to final results.

This paper was prepared by the writer with the intention of using it in the discussion of the Rapid Transit Report, which took place on the 7th of April, 1875, at a regular meeting of the American Society of Civil Engineers. The writer had previously made arrangements for the publication of the paper in this Journal, and it was decided at the meeting, that the communication could not be received, since all discussions become the property of the Society, and are copyrighted, if published. It has not been thought best to make any change in the paper, and these remarks will explain the reasons for its peculiar form, and the resolution at the end.

R. H. B.

ANALYSIS OF 38 PLANS FOR RAPID TRANSIT PRESENTED TO COMMITTEE OF THE AMERICA SOC

By RICHARD H. BUEL and SAMUEL BUEL, Jr. . . . . (From Table,

The standard, with which the designs are compared, is a synopsis of the conclusions reached by the Messrs. Buel in a paper presented to the Committee. The reasons for these conclusions will be found in the paper. It will be observed that the classification adopted serves to define essentially all the technical details of Rapid Transit, and renders it easy to judge at a glance of the value of any design in comparison with the assumed standard. If any one, whose plans are embraced in this statement, considers that he has been treated unfairly, it would seem proper for him to prove it by demonstrating the incorrectness of the conclusions by which he is judged. The writers are quite willing to admit that they may be in error, and will be thankful to any one who will point out their mistakes, and determine more accurate solutions of the details. It is worthy of remark that none of the designs were presented in such detail that a comparison of complete construction accounts and operating expenses could be made. In the report of the Committee, it is true, two elaborate estimates of operating expenses are given, but, as they differ from each other by about 25 per cent., they can not conveniently be compared with the assumed standard. In the design furnishing this standard the estimates given in *Foot Note L* are employed.

a. Standard Requirements for the Details.

A. General Details.

I. Gauge. 4'.8½"

Termini.

II. *Lower Terminus.* At the Battery.

III. *Upper Terminus.* Vicinity of 150th street.

Accessibility.

IV. *Distance between depots.* About one-half mile.

V. *Cross-town lines.* One in each cross street where main railway depots are located.

Location.

VI. *Number of lines.* Two lines of main railway.

VII. *Position of East side line above 14th street.* In 3rd Avenue.

VIII. *Position of West side line above 14th street.* In 8th Avenue.

IX. *Position of lines below 14th street.* As near as possible to Broadway.

X. *Loop lines.* One to each line of main railway, between 14th street and the City Hall.

XI. *Form of location at terminal train points.* Such that the run of each train is in the form of a belt.

Depots.

XII. *Access to trains.* A means of access to the trains without occasion for any person to cross a track at the level of the rails.

XIII. *Position with reference to tracks.* Between two tracks, at each stopping point, in such manner as to do service for them both.

XIV. *Length.* As great as that of the longest train.

XV. *Entrances.* Near the middle.

XVI. *Exits.* Distinct from the entrances and more capacious.

XVII. *Precautions against accidents to life and limb.* Sliding gates, to be opened and closed respectively with the arrival and departure of trains.

XVIII. *Strength.* Proportioned for an accidental load of not less than 100 pounds per square foot of floor area with a factor of 6.

XIX. *Position with reference to gradients.* Located upon short summit gradients, of approximately 100 feet per mile.

Coaches.

XX. *Seating capacity* Forty passengers.

XXI. *Arrangement of seats.* Divided seats of not less than 18 inches, arranged longitudinally

XXII. *Provisions for comfort and health.* Note B. The most approved methods of lighting, heating, and ventilating.

XXIII. *Provisions for safety.* Note B. Great strength of running gear, well devised brakes and couplings, and the most approved safety appliances for preventing derailment in case wheels or axles break.

XXIV. *Entrances and exits.* Separate doors for entrances and exits through the sides.

Motive Power.

XXV. *System.* Locomotives.

XXVI. *Capacity.* Proportioned to maintain a speed of 30 miles an hour, over gradients of 60 feet per mile, and curves of 500 feet radius, with a maximum train.

XXVII. *Running gear.* Truck or leading wheels, in addition to driving wheels.

XXVIII. *Adaptability to city use.* Neatly enclosed, smoke consuming, and so arranged as to drop no fire, water, oil or supplies.

Capacity.

XXIX. *Number of passengers per hour, each track main railways.* 8000.

. PLANS EXAMINED, ARRANGED IN ORDER OF MERIT.

No. 1. Richard P. Morgan, Jr.

Strain sheets and drawings of elevated way. Mr. Morgan alone is entitled to the credit of having presented an elevated way so full, that it could be compared with the standard, in every detail, and the estimate of its cost verified.

I. Gauge. Apparently 4' 8½"*
IV. *Distance between depots.* One-half mile.*
VI. *Number of lines.* Unsettled.
XII. *Access to trains.* No occasion to cross a track.*
XIII. *Position of depots, with reference to tracks.* One for each track.‡
XVII. *Provision for comfort and health in coaches.* Specified.*
XXIV. *Entrances and exits of coaches.* Specified.*
XXV. *System of motive power.* Locomotives.*
XXVIII. *Adaptability of locomotives to city use.* Specified.*
XXXV. *Method of operation.* Independent trains.*
LII. Character of *method of construction.* An elevated way.*
LIII. *Assumed rolling load.* 1st case, train and 6 ton engine.‡
2d case, 2000 pounds per linear foot of track.‡
LIV. *Factor of safety.* 6.*
LV. *Distance between columns, along the curb line.* 75 feet.*
LVII. *Approximate area of columns, per linear foot of structure.* 0.26 square feet.*
LIX. *Approximate distance between the building line and the nearest rail of tracks in the avenues.* 41 feet.*
LX. *Approximate distance between the building line and nearest edge of depot platforms, in the avenues.* 70 feet.‡
LXI. *Minimum clear headway.* As much as 14 feet.*
LXII. *Applicability to depot purposes, as specified under heads XIII. and XIV.* Not applicable.‡
LXIII. *Lateral bracing.* Largely omitted.‡
LXIV. *Approximate area of horizontal projection, per linear foot of structure.* 0.82 square feet.‡
LXV. *Approximate area of vertical projection, per linear foot of structure.* 2.29 square feet.*
LXVI. *Estimated cost per mile of double track.* 1st case $480,000, 2d case $801,104.
LXVII. *Cost per pound of wrought iron, upon which this estimate is based.* 8 cents.
LXVIII. *Cost per pound of cast iron, upon which this estimate is based.* 6 cents.

The cost of this structure increases with the width of the street. These estimates are for streets 46 feet wide between curb lines. By a revision of his estimates, Mr. Morgan reduces the amount to $446,000 and $717,994 per mile respectively. Upon a basis of 9 cents for wrought iron, and 6 cents for cast iron, the latter will amount to $874,000.

Mark, by which the relative standing is determined 156.2.

No. 2. Report of the Committee.

Note G.

I. Gauge. 4:8½*
II. *Position of lower terminus.* Unsettled.
III. *Position of upper terminus.* Unsettled.
IV. *Distance between depots.* One half mile.*
V. *Cross-town lines.* Unsettled.
VI. *Number of lines.* Two.*
VII. *Position of East side line above 14th street.* Unsettled.
VIII. *Position of West side line above 14th street.* Unsettled.
IX. *Position of lines below 14th street* Near Broadway.*
X. *Loop Lines.* Specified.*
XI. *Form of location at terminal train points.* Belt.*
XIV. *Length of depots.* About as great as that of the trains.*
XIX. *Position of depots, with reference to gradients.* Upon summits.*
XX. *Seating capacity of coaches.* About 40 passengers.*
XXI. *Arrangements of seats in coaches.* Unsettled.
XXIII. *Provisions for safety in coaches.* Specified *
XXIV. *Entrances and exits of coaches.* Specified.*
XXV. *System of motive power.* Locomotives.*
XXVI *Capacity of locomotives.* Specified *
XXVII. *Running gear of locomotives.* No truck or leading wheels.‡
XXVIII. *Adaptability of locomotives to city use.* Specified.*
XXIX. *Capacity of a track in passengers per hour.* Unsettled.
XXXI. *Rates of fare, main railways.* Unsettled.
XXXV. *Method of operation.* Independent trains.*
XLIX. *Independent routes for through travel.* Recommended.‡
LI. *Relations to longitudinal surface lines.* Identical.‡
LII. Character of *method of construction.* An elevated way.*

Some doubt existed as to whether the character of structure recommended should be classed as an elevated way, since underground methods of construction are proposed for certain portions of the lines. In their final conclusions, however, the Committee limited themselves to a cost, which renders only an elevated way admissible. This explanation is deemed necessary, since, under a rigid system of classification, this detail would have been rated as "unsettled."

LIII. *Assumed rolling load.* 1200 pounds per linear foot of track.‡
LIV. *Factor of safety.* 6.*
LVI. *Spans where the support is taken in the roadway* 50 feet.*
LVIII. *Transverse distance between columns in the roadway.* Unsettled.
LXVI. *Estimated cost per mile of double track.* Unsettled.

Mark by which the relative standing is determined. 147.2.

No. 3. S. B. B. Nowlan. Note H.

II. *Position of the lower terminus.* At the Battery.*
III. *Position of upper terminus.* Upper end of the Island.‡
IV. *Distance between depots.* one half mile.*
V. *Cross-town lines.* Referred to without detail.
VI. *Number of lines.* Two.*
VII. *Position of East side line above 14th street.* East River.‡
VIII. *Position of West side line above 14th street.* North River.‡
IX. Position of lines below 14th street. River Fronts.‡
XI. *Form of location at terminal train points.* Belt.*
XII. *Access to trains.* Elevators at depots.
XXV. *System of motive power.* Fireless locomotives.*
XXXV. *Method of operation.* Independent trains.*
LII. Character of *method of construction.* An elevated way.*
LV. *Spans, where the support is taken along the curb line* 50 feet.*
LVI. *Spans, where the support is taken in the roadway.* 50 feet.*
LVII. *Approximate area of columns, per linear foot of structure.* 0.05 square feet.*
LXI. *Minimum clear heading.* 14 feet.*
LXII. *Applicability to depot purposes, as specified under heads* XIII and XIV. Not applicable.‡

Mark by which the relative standing is determined. 115.5.

No. 4. T. D. Davis.

Drawing of elevated way and car, but no strain sheet.

I. Gauge. Single rail.‡
VI. *Number of lines.* One.‡
XII. *Access to trains.* No occasion to cross a track.*
XX. *Seating capacity of coaches.* About 40 passengers.*
XXI. *Arrangement of seats in coaches.* Longitudinal.*
XXIII. *Provision for safety in coaches.* Specified.*
XXIV. *Entrances and exits of coaches.* Specified.*
XXV. *System of motive power.* Locomotives.*
XXIX. *Capacity of a track in passengers per hour.* 2304.‡
XXXV. *Method of operation.* Independent trains.*
XLIII. *Collection of fares.* At the depots.*
XLV. *Number of employes upon duty, each train.* Specified.*
LII. Character of *method of construction.* An elevated way.*
LV. *Distance between columns along the curb line.* 25 feet.‡
LVII. *Approximate area of columns, per linear foot of structure.* 0.5 square feet.‡
LIX. *Approximate distance between the building lines and the nearest rail of tracks in the avenues.* 18 feet.‡
LXI. *Minimum clear headway.* As much as 14 feet.*
LXII. *Applicability to depot purposes as specified under heads* XIII. and XIV. Applicable.*
LXIV. *Approximate area of horizontal projection per linear foot of structure.* 0.89 square feet.*
LXV. *Approximate area of vertical projection per linear foot of structure.* 3.57 square feet.*
LXVI. *Estimated cost per mile of double track.* $150,000.

Mark by which the relative standing is determined. 113.3.

No. 5. E. M. Barnum. Note G.

II. *Position of lower terminus.* At the Battery.*
III. *Position of upper terminus.* Harlem and Manhattanville.‡
IV. *Distance between depots.* One half mile.*
VI. *Number of lines.* Two.*
VII. *Position of East side line above 14th street.* In Third and Fourth Avenues.‡
VIII. *Position of West side line above 14th street.* In Sixth Avenue and Broadway.‡
IX. *Position of lines below 14th street.* Bowery, Broadway.‡
XII. *Access to trains.* No occasion to cross a track.*
XIII. *Position of depot with reference to tracks.* One for each track.‡
XVII. *Precautions at depots against accidents to life and limb.* Specified.*
XXIV. *Entrances and exits of coaches.* Specified.*
XXV. *System of motive power.* Dummy engines.‡
XXXV. *Method of operation.* Independent cars.*
XLIII. *Collection of fares.* At the depots.*
LII. Character of *method of construction.* An elevated way.*
LV. *Distance between columns along the curb line.* 25 feet.‡
LVII. *Approximate area of columns per linear foot of structure.* 0.03 to 0.06 square feet.*
LXI. *Minimum clear headway.* 14 feet.*
LXII. *Applicability to depot purposes, as specified under heads* XIII and XIV. Applicable.*

Mark, by which the relative standing is determined. 113.0.

No. 6. Gilbert Elevated Railway Co. Note H.

II. *Position of lower terminus.* At the Battery.*
III. *Position of upper terminus.* Kingsbridge.‡
VI. *Number of lines.* Two.*
VII. *Position of East side line above 14th street.* In Second Avenue.‡
VIII. *Position of West side line above 14th street.* In Sixth Avenue.‡
IX. *Position of lines below 14th street.* Pearl street, West Broadway.‡
XI. *Form of location at terminal train points.* Belt.*
XII. *Access to trains.* No occasion to cross a track.*
XIII. *Position of depots, with reference to tracks.* One for each track.‡
XXV. *System of motive power.* Locomotive.*
XXXV. *Method of operation.* Independent trains.*
LII. Character of *method of construction.* An elevated way.*
LIII. *Assumed rolling load.* Train and 15 ton engine.‡
LIV. *Factor of safety.* 6.*
LV. *Distance between columns along the curb line.* About 60 feet.*
LVII. *Approximate area of columns per linear foot of structure.* 0.03 square feet.*
LIX. *Approximate distance between the building line and the nearest rail of tracks, in the avenues.* 41 feet.*
LX. *Approximate distance between the building line and nearest edge of depot platforms, in the avenues.* 30 feet.‡
LXII. *Applicability to depot purposes, as specified under heads* XIII and XIV. Not applicable.‡
LXVI. *Estimated cost per mile of double track.* $462,000.

Mark, by which the relative standing is determined. 104.6.

No. 7. Z. S. Durfee.—Note H.

I Gauge. 4.'8½."*
II. *Position of lower terminus.* At the Battery.*
III. *Position of upper terminus.* 125th street.‡
IV. *Distance between depots.* 2 blocks.‡
VI. *Number of lines.* Two.*
VII. *Position of East side line above 14th street.* In 3rd Avenue.*
VIII. *Position of West side line above 14th street.* In 8th Avenue.*
IX. *Position of lines below 14th street.* Bowery, Hudson street.‡
XI. *Form of location at terminal train points.* Belt.*
XII. *Access to trains.* Necessary to cross a track.‡
XXI. *Arrangement of seats in coaches.* Longitudinal.*
XXV. *System of motive power.* Locomotives.*
XXXI. *Rates of fare, main railways.* 5c. to 59th street, 7c. through.‡
XXXV. *Method of operation.* Independent trains.*
XLIX. *Independent routes for through travel.* Provided.‡
LII. Character of *method of construction.* An elevated way.*
LV. *Distance between columns along the curb line.* 25 feet.‡
LIX. *Approximate distance between the building line and nearest rail of tracks in the avenues.* 13 feet.‡
LX. *Approximate distance between the building line and nearest edge of depot platforms, in the avenues.* 4 feet.‡
LXII. *Applicability to depot purposes, as specified under heads* XIII. and XIV. Not applicable.‡

Mark, by which the relative standing is determined. 103.2

No. 8. John Wilkins.—Note H.

I. Gauge. Single rail.‡
II. *Position of lower terminus.* At the Battery.*
III. *Position of upper terminus* Harlem River.
IV. *Distance between depots.* 3 or 4 blocks.‡
VI. *Number of lines.* Two.*
VII. *Position of East side line above 14th street.* Unsettled.
VIII. *Position of West side line above 14th street.* 10th avenue.‡
IX. *Position of lines below 14th street.* Chatham, West or Hudson streets.‡
XI. *Form of location at terminal train points.* Belt.*
XII. *Access to trains.* No occasion to cross a track.*
XX. *Seating capacity of coaches.* 112 passengers.‡
XXII. *Provisions for comfort and health in coaches.* Specified.*
XXIV. *Entrances and Exits of coaches.* Specified.*
XXV. *System of motive power.* Unsettled.
XXXV. *Method of operation.* Independent cars.*
XLVII. *Route of trains.* Specified.*
XLVIII. *Stops.* At all stations.*
XLIX. *Independent routes for through travel.* Provided.‡
LI. *Relations to longitudinal surface lines.* Identical.‡
LII. Character of *method of construction.* An elevated way.*
LV. *Spans, where the support is taken along the curb line.* 100 feet.*
LVI. *Spans, where the support is taken in the roadway.* 100 feet.*

Mark, by which the relative standing is determined. 103.1.

No. 9. Roy Stone.—Note H.

I. Gauge. Single rail.‡
IV. *Distance between depots.* One-third mile.*
XII. *Access to trains.* No occasion to cross a track.*
XIII. *Position of depots, with reference to tracks.* One for both tracks.*
XX. *Seating capacity of coaches.* About 40 passengers.*
XXI. *Arrangement of seats in coaches.* Longitudinal.*
XXV. *System of motive power.* Locomotives.*
XXIX. *Capacity of a track in passengers per hour.* 4500.‡
XXXV. *Method of operation.* Independent trains.*
XXXVII. *Intervals between trains.* 5 to 6 minutes.‡
XLVIII. *Stops.* At all stations.*
L. *Average train speed.* 15 miles per hour.*
LII. Character of *method of construction.* An elevated way.*
LIX. *Approximate distance between the building line and the nearest rail of tracks in the avenues.* 18 feet.‡
LXI. *Minimum clear headway.* 14 feet.*
LXII. *Applicability to depot purposes, as specified under heads* XIII. and XIV. Applicable.*
LXVI *Estimated cost per mile of double track.* $200,000.

Mark, by which the relative standing is determined. 102.1.

No. 10. J. M. Hannahs.—Note H.

I. Gauge. 4' 8½".*
II. *Position of lower terminus.* Near the City Hall.‡
III. *Position of upper terminus* Harlem.‡
IV. *Distance between depots.* Variable.‡
VI. *Number of lines.* Three.‡
VII. *Position of East side line above 14th street.* Unsettled.
VIII. *Position of West side line above 14th street.* Unsettled.
IX. *Position of lines below 14th street.* Unsettled.
XI. *Form of location at terminal train points.* Belt.*
XII. *Access to trains.* No occasion to cross a track.*
XIII. *Position of depots, with reference to tracks.* One for each track.‡
XX. *Seating capacity of coaches.* 40 passengers.*
XXI. *Arrangement of seats in coaches.* Longitudinal.*
XXIII. *Provisions for safety in coaches.* Specified.*
XXV. *System of motive power.* Locomotives.*
XXVII. *Running gear of locomotives.* No truck or leading wheels.‡
XXIX. *Capacity of a track, in passengers per hour.* 7300.‡
XXXI. *Rates of fare, main railways.* 5c. for 5 miles, 1c. each additional mile.‡
XXXV *Method of operation.* Independent trains.*
XXXVI. *Hours of operation.* 16 hours.‡
XXXVII. *Interval between trains.* One minute if necessary.‡
XLIII. *Collection of fares.* At the depots.*
L. *Average train speed.* 12 miles per hour.‡
LII. Character of *method of construction.* An elevated way.*
LXII. *Applicability to depot purposes, as specified under heads* XIII. and XIV. Not applicable.‡

LXIV. *Approx*
linear foot of str
LXVI. *Estimat*
Mark, by whic
94.7

No. 11

Map of routes,
vated way for st
but no drawings
II. *Position of*
III. *Position o*
VI. *Number o*
VII. *Position o*
ington Avenue t
VIII. *Position*
Avenue, Broadw
IX. *Position o*
Broadway.‡
LII. Character
way.*
LV. *Spans, wh*
line. 48 to 52 fe
LVI. *Spans, w*
48 to 52 feet.*
LVIII. *Trans*
roadway. Abou
LXI. *Minimu*
LXV. *Approxi*
foot of structure
LXVI. *Estimat*
and $98,000, fo
Mark, by whic
94.4

No. 12.

IV. *Distance be*
XI. *Form of lo*
XII. *Access to*
XIII. *Position*
for each track.‡
XIV. *System o*
XXI. *Rate of*
XXV. *Method*
XXVI. *Hours*
XLVIII. *Stops*
passengers are
line at full speed
L. *Average tra*
LII. Character
way.*
LV. *Distance*
feet.*
LVI. *Estimat*
Mark, by whic
79.7

No. 13.

XI. *Seating ca*
XIII. *Provis*
XIV. *System*
XXI. *Rate of*
XXV. *Method*
L. *Average ca*
LII. Character
way.* This is
elevated by com
LVI. *Distance*
feet.*
LXI. *Minimum*
LXII. *Applica*
heads XIII. and
LXVI. *Estimat*
Mark, by whic
72.9

No. 14.

I. Gauge. U
IV. *Distance be*
X. *Access to*
XII. *Position*
for each track.‡
XIV. *System*
XXV. *Method*
LII. Character
way.*
LV. *Distance*
to 52 feet.*
LVI. *Approxi*
structure. 0.1 sq
LVII. *Transve*
way. 9 feet.‡

(From Table, accompanying Discussion upon pages, 249, 250, 251.)

XIX. *Cross-town lines.* Approximately equal in capacity to that of the main railways.

RATES OF FARE.

XXXI. *Travel between points upon the main railways.* 5 cents.

XXXII. *Travel between points not upon the main railways.* An average of 5½ cents.

XXXIII. *Parlor accommodation.* Additional rate, for not more than 20 per cent. of travel, of 5 cents.

XXXIV. *Travel in a cross-town direction only.* Less than 5 cents.

OPERATION OF THE LINES.

XXXV. *Method of operation.* By means of independent trains.

XXXVI. *Hours of operation.* Continuously.

XXXVII. *Interval, between trains, below 59th street, between the hours of 6 A.M. and 12 P.M.* Note G. 1½ to 3 minutes.

XXXVIII. *Interval between trains, below 59th street, between the hours of 12 P.M. and 6 A.M.* 10 minutes.

XXXIX. *Interval between trains, above 59th street, between the hours of 6 A.M. and 12 P.M.* 6 minutes.

XL. *Interval between trains, above 59th street, between the hours of 12 P.M. and 6 A.M.* 10 minutes.

XLI. *Interval between cars of cross-town lines, between the hours of 6 A.M. and 12 P.M.* 1½ to 2 minutes.

XLII. *Interval between cars of cross-town lines, between the hours of 12 P.M. and 6 A.M.* 5 minutes.

XLIII. *Collection of fares.* As far as possible at the depot entrances.

XLIV. *Number of employés upon duty at each depot.* Two depot masters, in addition to collector of fares.

XLV. *Number of employés upon duty each train.* One engineer, one fireman, and one conductor or assistant conductor to every 3 coaches.

XLVI. *Dress of employés.* All employés, whose duties bring them into contact with the public, neatly uniformed.

XLVII. *Route of trains.* The run of a portion of the trains only between 59th street and the Battery.

XLVIII. *Stops.* At all stations.

XLIX. *Independent routes for through travel.* Impracticable in the initial system of Rapid Transit.

L. *Greatest average train speed attainable.* 15 miles per hour.

LI. *Relation of main lines of railway to longitudinal surface lines.* Directly opposed.

B. METHOD OF CONSTRUCTION.

LII. *Character.* An elevated way.

DETAILS OF ELEVATED WAY.

LIII. *Assumed rolling load per linear foot of track.* 3000 pounds.

LIV. *Factor of safety.* 6.

LV. *Spans, where the support is taken along the curb line.* Not less than 30 feet.

LVI. *Spans, where the support is taken in the roadway.* Not less than 40 feet.

LVII. *Approximate area of supporting columns, per linear foot of structure.* Note D. 0.04 square feet.

LVIII. *Transverse distance between columns, where the support is taken in the roadway.* 21 feet.

LIX. *Approximate distance between the building line and the nearest rail of tracks in the avenues.* Note E. 37 feet.

LX. *Approximate distance between the building line and nearest edge of depot platforms in the avenues* Note E. 43 feet.

LXI. *Minimum clear headway.* 14 feet.

LXII. *Applicability to depot purposes.* Susceptible of depot arrangement, as specified under heads XIII and XIV.

LXIII. *Lateral bracing.* As efficient as is usual in good bridge practice.

LXIV. *Approximate area of horizontal projection per linear foot of structure.* Note D. 3.39 square feet.

LXV. *Approximate area of vertical projection per linear foot of structure.* Note D. 2.63 square feet.

LXVI. *Estimated cost per mile of double track.* $450,000.

LXVII. *Cost per pound of wrought iron upon which this estimate is based.* 9 cents.

LXVIII. *Cost per pound of cast iron upon which this estimate is based.* 6 cents.

C. MARK BY WHICH THE RELATION IS DETERMINED. Note F.

☞ For the Standard, 382.0.

LXIV. *Approximate area of horizontal projection, per linear foot of structure.* 13.0 square feet.‡

LXVI. *Estimated cost per mile of double track.* $300,000. Mark, by which the relative standing is determined. 94.7.

No. 11. Chas. H. Haswell.

Map of routes, side elevation and cross section of elevated way for streets up to 46 feet between curb lines, but no drawings of designs for wider streets.

II. *Position of lower terminus.* At the Battery.*

III. *Position of upper terminus.* Spuyten Duyvel.‡

VI. *Number of lines.* Two.*

VII. *Position of East side line above 14th street.* Lexington Avenue to 42d street.‡

VIII. *Position of West side line above 14th street.* 6th Avenue, Broadway and 10th Avenue.‡

IX. *Position of lines below 14th street.* Bowery, West Broadway.‡

LII. CHARACTER *of method of construction.* An elevated way.*

LV. *Spans, where the support is taken along the curb line.* 46 to 52 feet.*

LVI. *Spans, where the support is taken in the roadway.* 46 to 52 feet.*

LVIII. *Transverse distance between columns in the roadway.* About 20 feet.*

LXI. *Minimum clear headway.* 13 feet.*

LXV. *Approximate area of vertical projection per linear foot of structure* 2.58 square feet.*

LXVI. *Estimated cost per mile of double track.* $371,513 and $198,000, for narrow and wide streets, respectively. Mark, by which the relative standing is determined. 94.6.

No. 12. Alfred Speer.—Note H.

IV. *Distance between depots.* Two blocks.‡

XI. *Form of location at terminal train points.* Belt.*

XII. *Access to trains.* No occasion to cross tracks.*

XIII. *Position of depots with reference to tracks.* One for each track.‡

XIV. *System of motive power.* Fixed engines.‡

XVII. *Capacity of a track in passengers per hour.* At least as great as 8000.*

XXII. *Rate of fare, main railway.* 5 cents.*

XXIV. *Method of operation.* Continuous train.‡

XXVI. *Hours of operation.* 18 hours.‡

XLVIII. *Stops.* By means of an ingenious device, passengers are transferred to and from the train moving at full speed.*

L. *Average train speed.* 15 miles per hour.*

LII. CHARACTER *of method of construction.* An elevated way.*

IV. *Distance between columns along the curb line* 30 feet.*

LXVI. *Estimated cost per mile of double track.* $200,000. Mark, by which the relative standing is determined. 79.1.

No. 13. Robert A. Chesebrough.

Notes H. and J.

XI. *Seating capacity of coaches.* 30 passengers.‡

XIII. *Provisions for safety in coaches.* Specified.*

XIV. *System of motive power.* Fixed engines.‡

XXII. *Rate of fare, main railway.* 5 cents.*

XXIV. *Method of operation.* Independent cars.*

L. *Average car speed.* About 15 miles per hour.*

LII. CHARACTER *of method of construction.* An elevated way.* This is a gravity road, in which the cars are elevated by compressed air, and run down inclines

LVI. *Distance between columns, along the roadway.* 125 feet.*

LXI. *Minimum clear headway.* 12½ feet.*

LXII. *Applicability to depot purposes as specified under heads* XIII. and XIV. Not applicable.‡

LXVI. *Estimated cost per mile of double track.* $90,000. Mark, by which the relative standing is determined, 72.9.

No. 14. A. E. Lozier.—Note I.

I. GAUGE. Unsettled.

IV. *Distance between depots.* One-fourth mile.‡

XII. *Access to trains.* No occasion to cross a track.*

XIII. *Position of depots, with reference to tracks.* One for each track.‡

XIV. *System of motive power.* Locomotives.*

XXIV. *Method of operation.* Independent trains.*

LII. CHARACTER *of method of construction.* An elevated way.*

LVI. *Distance between columns, along the roadway.* 25 to 50 feet.‡

LVII. *Approximate area of columns, per linear foot of structure.* 0.1 square foot.‡

LVIII. *Transverse distance between columns in the roadway.* 9 feet.‡

LIX. *Approximate distance between the building line and the nearest rail of tracks in the avenue.* 43 feet.*

LXI. *Minimum clear headway.* 14 feet.*

LXII. *Applicability to depot purposes, as specified under heads* XIII. *and* XIV. Not applicable.‡

LXV. *Approximate area of vertical projection, per linear foot of structure.* 3.28 square feet.*

LXVI. *Estimated cost per mile of double track.* $180,000. Mark by which the relative standing is determined. 72.2.

No. 15. WM. J. FRYER.—Note G.

II. *Position of lower terminus.* At the Battery.*

III. *Position of upper terminus.* Upper end of the island.‡

VI. *Number of lines.* Two.*

VII. *Position of East side line, above 14th street.* East River.‡

VIII *Position of West side line above 14th street.* North River.‡

IX. *Position of lines below 14th street.* River Fronts.‡

XI. *Form of location at terminal train points* Belt.*

XXII. *Provisions for comfort and health in coaches.* Specified.*

XXV. *System of motive power.* Unsettled.

XXXV. *Method of operation.* Independent trains.*

L. *Average train speed.* 20 miles per hour.‡

LII. CHARACTER *of method of construction.* An elevated way.*

LVI. *Distance between columns along the roadway.* 30 feet.‡

LXI. *Minimum clear headway.* 16 feet.*

Mark by which the relative standing is determined, 71.3.

No. 16. Chas. Macdonald. Note G.

XII. *Access to trains.* No occasion to cross a track.*

XIII. *Position of depots with reference to tracks.* One for each track.‡

XX *Seating capacity of coaches.* About 40 passengers.*

XXIX. *Capacity of a track in passengers per hour.* 5,400 ‡

XXXV. *Method of operation.* Independent trains.*

XXXVII. *Interval between trains.* One minute ‡

L. *Average train speed.* 20 miles per hour.‡

LII. CHARACTER *of method of construction.* An elevated way.*

LV. *Spans, where the support is taken along the curb line.* 50 feet.*

LVI. *Spans, where the support is taken in the roadway.* 50 feet.*

LXII. *Applicability to depot purposes, as specified under heads* XIII. *and* XIV. Applicable.*

LXVI. Estimated cost per mile of double track. $250,000.

Mark by which the relative standing is determined. 71.1.

No. 17. J. Dutton Steele. Note G.

I. GAUGE. 3'.‡

V. *Cross-town lines.* Referred to without detail.

VI. *Number of lines.* Two.*

VII. *Position of East side line above 14th street.* East River.‡

VIII. *Position of West side line above 14th street.* North River.‡

IX. *Position of lines below 14th street.* River Fronts.‡

LI. *Relations to longitudinal surface lines.* Identical.‡

LII. CHARACTER *of Method of construction.* An elevated way.*

LVI. *Distance between columns, along the roadway.* 50 to 60 feet.*

LVIII. *Transverse distance between columns in the roadway.* 28 feet.*

LXI. *Minimum clear headway.* 12 or 14 feet.*

LXII. *Applicability to depot purposes, as specified under heads* XIII. *and* XIV. Not applicable.‡

Mark by which the relative standing is determined. 61.2.

No. 18. C. Williams. Note H.

I. GAUGE. 4'‡

XXV. *System of motive power.* Locomotives.*

XXXV. *Method of operation.* Independent trains.*

LII. CHARACTER *of method of construction.* An elevated way.*

Continuous suspension bridges, with spans approximately equal to the length of the blocks.

LV. *Distance between columns, along the curb line.* 230 to 260 feet.*

LIX. *Approximate distance between the building line and the nearest rail of tracks in the avenues.* 43 feet.*

LXII. *Applicability to depot purposes, as specified under heads* XIII. *and* XIV. Not applicable.‡

Mark, by which the relative standing is determined. 59.7.

No. 19. Richard Montgomery. Note H.

XXV. *System of motive power.* Dummy Engines.‡

XXXV. *Method of operation.* Independent cars.*

LII. CHARACTER *of method of construction.* An elevated way.*

Built of patent corrugated beams, for which the inventor claims the combination of economy and strength.

LV. *Distance between columns along the curb line.* 25 feet.‡

LXI. *Minimum clear headway.* 15 feet.*

LXII. *Applicability to depot purposes, as specified under heads* XIII. *and* XIV. Applicable.*

Mark, by which the relative standing is determined. 54.4.*

No. 20. John F. Burgin.—Note I.

I. GAUGE. 3'.‡

II. *Position of lower terminus.* At the Battery.*

III. *Position of upper terminus.* Harlem River.

VI. *Number of lines.* One.‡

XII. *Access to trains.* No occasion to cross a track.*

XIII. *Position of depots, with reference to tracks.* One for each track.‡

XXV. *System of motive power.* Atmosphere system.

XXIX. *Capacity of a track in passengers per hour.* 1,200.‡

LII. CHARACTER *of method of construction.* An elevated way.*

LIX. *Approximate distance between the building line and the nearest rail of tracks in the avenues.* 17 feet.‡

LX. *Approximate distance between the building line and nearest edge of depot platforms, in the avenues.* 0 feet.‡

LXII. *Applicability to depot purposes, as specified under heads* XIII. *and* XIV. Applicable.*

Mark, by which the relative standing is determined. 53.4.

No. 21. Metropolitan Transit Railway Co.—Note H.

II. *Position of lower terminus.* At the Battery.*

III. *Position of upper terminus.* Kingsbridge.‡

IV. *Distance between depots.* One-half mile.*

VI. *Number of lines.* One.‡

VII. *Position of line above 14th street.* Near 6th, 7th, 8th, and 9th Avenues.‡

IX. *Position of line below 14th street.* Near Church and Greene streets.*

XIII. *Position of depots, with reference to tracks.* An illustration represents a common depot for both tracks. This is impracticable upon a width of 25 feet, to which the designer limits the right of way.

XX. *Seating capacity of coaches.* 66 passengers.‡

XXV. *System of motive power.* Dummy engines.‡

XXIX. *Capacity of a track in passengers per hour.* 7920.*

XXXV. *Method of operation.* Independent cars.*

XXXVI. *Hours of operation.* Not continuously.‡

XXXVII. *Interval between cars.* One-half minute.‡

XLIX. *Independent routes for through travel.* Provided.‡

LI. *Relations to longitudinal surface lines.* Identical.‡

LII. CHARACTER *of method of construction.* Three tier railway.‡

Mark, by which the relative standing is determined. 52.8.

No. 22. G. W. Fitts.—Note H.

XII. *Access to trains.* No occasion to cross a track.*

XIII. *Position of depots, with reference to tracks.* One for both tracks.*

XIV. *Length of depots.* Continuous.*

XX. *Seating capacity of coaches.* 8 or 10 passengers.‡

XXV. *System of motive power.* Fixed engines.‡

XXXV. *Method of operation.* Independent cars.*

LII. CHARACTER *of method of construction.* An elevated way.* Cars suspended from tracks overhead, moved by endless ropes, from which they can be detached at the will of the conductor.

LXII. *Applicability to depot purposes, as specified under heads* XIII. *and* XIV. Applicable.*

Mark, by which the relative standing is determined, 52.7.

No. 23. John B. Church.—Note H.

II. *Position of lower terminus.* Near the City Hall.‡

XXV. *System of motive power.* Locomotives.*

XXXV. *Method of operation.* Independent trains.*

LII. CHARACTER *of method of construction.* An elevated way* Each span is supported upon three columns, the outer two of which rest upon stone bases, rendering the intermediate spaces available for the use of street cars, but not for ordinary traffic.

LVIII. *Transverse distance between columns, in the roadway.* 9 feet.‡

LIX. *Approximate distance between the building li and the nearest rail of tracks.* 42 feet.*

LXII. *Applicability to depot purposes, as specified under heads* XIII *and* XIV. Not applicable.‡

Mark, by which the relative standing is determined. 49.9.

No. 24. J. Griscom.—Note H.

IV. *Distance between depots.* One mile.‡

VI. *Number of lines.* One.‡

XVI. *Depot exits.* Specified.*

XXII. *Provisions for comfort and health in coaches.* Specified.*

XXIII. *Provisions for safety in coaches.* Specified.*

XXIV. *Entrances and exits of coaches.* Specified.*

XXV. *System of motive power.* Compressed air dummy engines.‡

XXXV. *Method of operation.* Independent cars.*

XXXVII. *Interval between cars.* About, 2½ minutes.*

XLIII. *Collection of fares.* At the depots.*

XLVIII. *Stops.* At all stations.*

LI. *Relations to longitudinal surface lines.* Identical.‡

LII. CHARACTER *of method of construction.* A tunnel.‡

Mark, by which the relative standing is determined. 45.3.

No. 25. G. L. Haussknecht.—Note G.

XXV. *System of motive power.* Fixed engines.‡

XXXI. *Rate of fare, main railway.* 3 cents.*

XXXV. *Method of operation.* Independent trains.*

XXXVII. *Interval between trains.* One minute.‡

L. *Average train speed.* 20 miles per hour.‡

LII. CHARACTER *of method of construction.* An elevated way.* The cars are suspended about a foot above the ground from an overhead tube, which contains the running gear, driven by compressed air.

Mark, by which the relative standing is determined. 41.6.

No. 26. T. C. Bartlett.—Notes G. & J.

I. GAUGE. Single rail.‡

XXV. *System of motive power.* Locomotives.*

XXXI. *Rate of fare, main railway.* One cent per mile.‡

XXXV. *Method of operation.* Independent trains.*

L. *Average train speed.* 60 miles per hour.‡

LII. CHARACTER *of method of construction.* An elevated way.*

LXVI. *Estimated cost per mile of double track.* $211,200 Mark, by which the relative standing is determined. 40.1.

No. 27. New York Arcade Railway Company.—Note K.

II. *Position of lower terminus.* At the Battery.*

IV. *Distance between depots.* One-half mile.*

VI. *Number of lines.* One.‡

XII. *Access to trains.* Necessary to cross a track.‡

XXV. *System of motive power.* Locomotives.*

XXXI. *Rates of fare, main railway.* 10 cents local, 15 cents through.‡

XXXV. *Method of operation.* Independent trains.*

XLIX. *Independent routes for through travel.* Provided.‡

LII. CHARACTER *of method of construction.* An undersurface road.‡

LXII. *Applicability to depot purposes, as specified under heads* XIII. *and* XIV. Not applicable.‡

LXVI. *Estimated cost per mile of quadruple track.* $2,096,930.

Mark by which the relative standing is determined, 40.0.

No. 28. I. B. Tibbitts.—Note G.

I. GAUGE. 4' 8½".*

II. *Position of lower terminus.* Fulton street and Broadway.‡

III. *Position of upper terminus.* 34th street.‡ Contemplates using the Park Avenue Tunnel, 4th Avenue Improvement, and connections, to Spuyten Duyvel.

IV. *Distance between depots* Variable.‡

V *Cross-town lines.* A tunnel under 34th street.

VI. *Number of lines.* One.‡

VII. *Position of line above 14th street.* In 4th avenue.‡

IX. *Position of line below 14th street.* Near Broadway.‡

XXV. *System of motive power.* Unsettled.

XXXI. *Rates of fare.* Same as existing surface lines.‡

XXXIII *Parlor accommodation.* Disapproved.‡

XXXV. *Method of operation* Independent trains *

LI. *Relations to longitudinal surface lines.* Identical.‡

Contemplates using all existing lines under control of a Bureau.

LII. CHARACTER *of method of construction.* A tunnel, depressed and surface road.‡

Mark by which the relative standing is determined, 39.3.

No. 29. N. Y. C. C. Underground Railway Co.—Note G.

II. *Position of lower terminus.* Near the City Hall.‡
III. *Position of upper terminus.* 130th street.‡
IV. *Distance between depots.* One-half mile.*
VI. *Number of lines.* One.‡
VII. *Position of line above 14th street.* Madison Avenue.‡
IX. *Position of line below 14th street.* Near Broadway.*
XIX. *Position of depots, with reference to gradients.* Upon summits.*
XXV. *System of motive power.* Locomotives.*
XXXI. *Rate of fare, main railway.* 6 cents.‡
XXXV. *Method of operation.* Independent trains.*
XXXVI. *Hours of operation.* 19 hours.‡
LII. CHARACTER *of method of construction.* A tunnel and brick viaduct.‡
LXVI. Estimated cost per mile of double track, $1,662,000.
Mark by which the relative standing is determined, 33.6

No. 30. I. X. L.—Note G.

II. *Position of lower terminus.* At the Battery.*
III. *Position of upper terminus.* 57th or 59th street.‡ Contemplates to connect with, and use locomotives upon, surface roads above 59th street.
V. *Cross-town lines.* A cross-town line in 57th or 59th, 30th and Chambers streets.
VI. *Number of lines.* Two.*
VII. *Position of East side line above 14th street.* East River.‡
VIII. *Position of West side line above 14th street.* North River.‡
IX. *Position of lines below 14th street.* River Fronts.‡
XXV. *System of motive power.* Horses.‡
XXXI. *Rate of fare, main railway.* 5 cents.*
XXXV. *Method of operation* Independent cars.*
L. *Average car speed.* 5 miles per hour.‡
LII. CHARACTER *of method of construction.* A surface road.‡
LXVI. Estimated cost per mile of double track, $40,000.
Mark by which the relative standing is determined, 32.4.

No. 31. I. X. L.—Note G.

II. *Position of lower terminus.* Near the City Hall.‡
III. *Position of upper terminus.* Central Park.‡
IV. *Distance between depots.* One-half mile.*
VI. *Number of lines.* One.‡
VII. *Position of line above 14th street.* Near 3rd avenue.*
IX. *Position of line below 14th street.* Near the Bowery.‡
XXV. *System of motive power.* Locomotives.*
XXXV. *Method of operation.* Independent trains.*
L. *Average train speed.* 18 miles per hour.‡
LII. CHARACTER *of method of construction.* A masonry viaduct, through the blocks.‡
LXVI. Estimated cost per mile of double track, $2,100,000.
Mark by which the relative standing is determined, 30.9.

No. 32. Manhattan Railway Co.

Note G.

II. *Position of lower terminus.* At the Battery.*
VI. *Number of lines.* One.‡.
VIII. *Position of line above 14th street.* Broadway, 7th avenue.‡
IX. *Position of line below 14th street.* Broadway.‡
XXV. *System of motive power.* Locomotives.*
XXXV. Method of operation. Independent trains.*
LII. CHARACTER *of method of construction.* A tunnel.‡
Mark by which the relative standing is determined, 26.4.

No. 33. I. I. Williams.—Note G.

II. *Position of lower terminus.* At the Battery.‡
III. *Position of upper terminus.* 30 miles from the Battery.‡
IV. *Distance between depots.* One-eighth mile.
VI. *Number of lines.* One.‡
VIII. *Position of line above 14th street.* Broadway, 8th avenue.‡
IX. *Position of line below 14th street.* Broadway.‡
XXI. *Arrangement of seats in coaches.* Transverse.‡
XXIII. *Provisions for safety in coaches.* Specified.*
XXIV. *Entrances and exits of coaches.* Identical.‡
XXXI. *Rate of fare, main railway.* 15 cents.‡
XXXV. *Method of operation.* Independent trains.*
XXXVI. *Hours of operation.* 19 hours.‡
LII. CHARACTER *of method of construction.* A tunnel, sunken track and surface road.‡
LXVI. *Estimated cost per mile of double track.* $204,167.
Mark by which the relative standing is determined, 25.3.

No. 34. Broadway Underground Railway Co.—Note H.

II. *Position of lower terminus.* At the Battery.*
III. *Position of upper terminus.* North side of Harlem River.
VI. *Number of lines.* One line and branch.‡
VII. *Position of East side line above 14th street.* Madison Avenue.‡
VIII. *Position of West side line above 14th street.* Broadway to 59th street.‡
IX. *Position of line below 14th street.* Broadway.‡
XXXI. *Rates of fare, main railway.* 8 to 10 cents, generally the latter.‡
LII. CHARACTER *of method of construction.* A tunnel.‡
Mark by which the relative standing is determined. 13.6.

No. 35. P. J. Hardy.—Note H.

VI. *Number of lines.* Two.*
XI. *Form of location at terminal train points.* Belt.*
XIX. *Position of depots, with reference to gradients.* Upon summits at the surface.*
LII. CHARACTER *of method of construction.* A tunnel.‡
Mark by which the relative standing is determined. 11.7.

No. 36. Chas. E. Hill.—Note K.

VI. *Number of lines.* Two.*
VII. *Position of East side line above 14th street.* East River.‡
VIII. *Position of West side line above 14th street.* North River.‡
IX. *Position of lines below 14th street.* River Fronts.‡
XLIX. *Independent routes for through travel.* Provided.
LII. CHARACTER *of method of construction.* Iron and masonry viaduct upon HILL'S patent columns.‡
Mark by which the relative standing is determined. 4.5.

No. 37. L. Bernheimer.—Note H.

VI. *Number of lines.* Two.*
VII. *Position of East side line above 14th street.* East River.‡
VIII. *Position of West side line above 14th street.* North River.‡
IX. *Position of lines below 14th street.* River Fronts.‡
XLIX. *Independent routes for through travel.* Provided.‡
LII. CHARACTER *of method of construction.* A masonry viaduct.‡
Mark by which the relative standing is determined. 4 5.

REFERENCE NOTES:
* Within the standard requirements:
‡ Opposed to the standard requirements.
Note A. In the analysis of a design, positive recommendations or assertions, whether sustained by argument or not, are specified either as being in accordance with, or opposed to, the standard requirements. Details which have been considered without a conclusion having been reached, are characterized as "unsettled." The omission of any one of the LXVIII. numbers, which appear in the standard, indicates that no mention is made of the detail to which it refers, or, in the case of cost and dimensions of elevated way, that insufficient data are given.

The Committee state in their report, that they examined 75 plans. The writers, however, found only 36 (with drawings, and references to several others) in the Library of the Society, upon the 11th of March, 1875. It may be, therefore, that some of the plans analyzed were presented in greater detail, and with more complete drawings than appeared under their examination upon the above date.

Note B. This detail was not as fully defined, in any of the plans examined, as the standard requirements, and the spirit, rather than the letter, of the specification has been considered by the writers.

Note C. No reference was made in regard to time or place, in any of the designs in which the interval between trains was specified.

Note D. All other things being equal, that elevated way is least objectionable, in which this area is a minimum.

Note E. All other things being equal, that elevated way is least objectionable, in which this distance is a maximum.

Note F. The marks for determining the order of merit of each design are obtained in the following manner:

Every detail, which is correctly specified, receives the mark expressing the value of that detail. Every detail, which is incorrectly specified, unsettled, or omitted, is marked zero. The sum of the marks, for each design, is then taken, and the design having the highest mark ranks as the first. Each detail, of a class, has the same value, equal to the quantity expressing the value of the class, divided by the number of details which it contains. In assigning these values, it is assumed:—1st, that "Gauge," "Character of Road," "Termini," "Accessibility," "Location," "Rates of Fare," and "Capacity," have each the same value, and that the sum of these values is half that of all the details. 2d That "Depots," "Coaches," and "Motive Power," have each the same value, and that the sum of these values is one-sixth that of all the details. 3rd. That "Operation of the Lines," and "Details of Elevated Way," have each the same value, and that the sum of these values is one-third that of all the details.

Note G. No strain sheets or drawings.
Note H. No strain sheets. Illustrations not to scale, or scale omitted.
Note I. No strain sheets. Side elevation and cross section, but no plan of elevated way.
Note J. Model.
Note K. Drawings of proposed structure.
Note L. 1ST. GENERAL DATA.

2ND.—CONSTRUCTION ACCOUNT IN DETAIL.

DETAIL.	RATE.	Cost. Total.	Cost. Per mile of elevated way.	Cost per mile of double track of cross-town lines, equipment, and appurtenances.
26 miles—double track elevated way	$450,000	$11,700,000	$450,000	$92,000
6 Acres—right of way	1,000,000	6,000,000	330,769	
60 Depots	25,000	1,500,000	57,692	
Shops, engine-houses, yard-room, etc.	.....	1,000,000	38,461	
38o Forty-seated coaches	4,500	1,710 000	65,769	
90 Parlor coaches	6,000	540,000	20,769	
120 Locomotives	10,000	1,200,000	46,153	
45 Miles—double track street railway	20,000	900,000	34,616	
650 Street cars	1,200	780,000	30,000	17,334
3,300 Horses	200	660,000	25,385	14,666
9 Street car houses	200,000	1,800,000	69,233	40,000
		$27,790,000	$1,068,847	
			$159.234	$228,844

1ST.—GENERAL DATA.

Maximum number in service simultaneously of		Total Annual Mileage of			Total number of seats offered for annum, supposing each passenger to travel over the whole train or car routes.		
Cross-town cars.	Elevated Railway trains.	Cross-town cars.	Elevated Railway trains.		Elevated Railway trains at 200 seats per train.	Cross-town cars, at 16 seats per car.	
600	72	23,491,990	7,439,990		220,272,000	200,401,920	

3D. OPERATING EXPENSES, PER ANNUM, IN DETAIL.

Detail.	Rate.	Total.	Cost. Per car mile, cross-town lines only.	Cost. Per train mile. Elevated Railway only.	Cost. Per train mile. Elev. Rail'y, and cross-town lines.
160 Engineers	$1,080	$172,800	$ ..	$0.02½	$0.02½
160 Firemen	840	134,400	..	0.02	0.02
160 Conductors	840	134,400	..	0.02½	0.02½
160 Assistant Conductors	840	134,400	..	0.02	0.02
168 Agents at depots	1,080	181,440	..	0.02½	0.02½
336 Depot masters	840	282,240	..	0.03½	0.03½
1300 Street car drivers	840	1,092,000	0.04½	..	0.04½
Watchmen, switch tenders, &c.	....	100,000	..	0.01½	0.01½
Locomotive fuel and stores	20 per ct. upon cost.	400,000	..	0.05½	0.05½
Maintenance and depreciation of locomotives	15 " " "	240,000	..	0.03	0.03
" " coaches	....	337,500	..	0.04½	0.04½
" " elevated way and buildings	....	400,000	..	0.05½	0.05½
" " horses	3300×$250	825,000	0.03½	..	0.04½
" " cross-town property, other than horses	....	300,000	0 01½	..	0.01½
Superintendence and miscellaneous expenses	....	500,000	0.00½	0.05	0.06
		$5,092,740	$0.10	$0.40	$0.72

CONCLUDING NOTE.

Some of the designers may object to being criticized for their neglect of the general details, alleging their perfect right to confine their investigation to the method of construction only. Upon technical grounds, however, they have no right to complain. The position of termini, means of accessibility, and degree of capacity required, must be fixed before the extent of route can be determined. Moreover, the extent of route, gauge, gradients, curvature, character of depots, motive power and coaches, length of trains, mileage of cars and trains, and number of employés required, must be determined, to enable estimates to be made of the cost of equipment, depots, and expenses. Again, it is necessary to know, not only the cost of these latter details, but the rate of fare, before it can be satisfactorily demonstrated that the cost of any proposed method of construction is, or is not, prohibitory; since, for this purpose, the cost per mile of any proposed system, multiplied by the number of miles required, and added to the cost of equipment, depots, etc., must be considered in connection with the fixed rates of fare, operating expenses, and greatest possible patronage.

So far, then, from the method of construction being a matter for arbitrary decision, it is correctly determined by the consideration of a series of steps leading up to it; and it would seem that the Committee, in common with most of those who submitted plans, in assuming a method of construction other than as a logical conclusion to the careful consideration of all those steps, began at the wrong end of the question.

COAL TRADE REVIEW.

Import Duty on Coal.

Anthracite free. *Bituminous*, per ton of 28 bushels, 80 lb. to the bushel, 75c., gold.

All *slack*, or *culm*, such as will pass through a half-inch screen, per ton of 28 bushels, 80 lb. per bushel, 40c., gold.

Not otherwise provided for, per ton, 40c. gold.

This is the only report published that gives full and accurate returns of the production of our Anthracite mines.

NEW YORK, April 10, 1875.

Comparative Statement of the Production of Anthracite Coal for the week ending April 3:

	1875,		1874,	
	Week.	Year.*	Week.	Year.
Wyoming Region.				
D. and H. Canal Co.	56,765	646,985	56,158	552,031
D. L. and W. RR. Co	79,123	620,954	52,202	559,512
Penn. Coal Co.	31,967	259,950	21,263	261,450
L. V. RR. Co.	12,125	231,204	18,886	237,161
P. and N. Y. RR. Co.	1,890	7,357	1,974	13,127
C. Rl. of N. J.	4,418	53,187	27,420	251,963
Penn. Canal	..	..	..	..
Lack. and B. RR.	..	28,696	..	28.831
	185,686	1,848,333	177,903	1,904,075
Lehigh Region.				
L. V. RR. Co.	5,797	105,232	56,767	669,724
C. RR. of N. J.	428	5,499	26,092	159,338
D. H. and W. B. RR.	..	6,132	889	3,624
	6,225	116,863	83,748	832,686
Schuylkill Region				
P. and R. R. RR. Co.	17,234	230,287	121,769	843,760
Shamokin and Lykens Val.	25,995	172,171	10,878	128,533
	43,229	402,458	134,647	972,293
Sullivan Region.				
Sul. and Erie RR. Co	407	3,537	331	6,173
Total	235,547	2,371,191	396,629	3,715,227
Increase	..	..	..	..
Decrease	161,082	1,344,036	..	..

* Year beginning January 1st.

The above table does not include the amount of coal consumed and sold at the mines, which is about five per cent. of the whole production

The following table does not give the entire production of our bituminous mines, but it is by far the fullest report published.

The Production of Bituminous Coal for the week ending April 3, was as follows:

Tons of 2000 lb., except where otherwise designated.

	Week. Tons.	Year. Tons.
Cumberland Region, Md.		
Tons of 2240 lb.	34,854	257,680
Barclay Region, Pa.		
Barclay R.R. tons of 2240 lb.	5,956	77,946
Broad Top Region, Pa.		
Huntingdon & Broad Top R.R.	5,086	48,833
East Broad Top	842	6,719
Clearfield, Region, Pa.		
Snow Shoe	1,603	18,434
Tyrone and Clearfield	22,368	187,832
Allegheny Region, Pa.		
Pennsylvania R.R.	3,006	46,685
Pittsburgh Region, Pa.		
West Penn. R.R.	3,893	43,462
Southwest Penn. R.R.	149	1,448
Penn. and Westmoreland gas coal, Pa. RR.	4,105	143,657
Pennsylvania R.R.	5,805	61,741
Kanawha Region, W. Va.		
Chesapeake and Ohio R.R.	3,505	26,357

The Production of Coke for the week ending March 28.

Tons of 2000 lb.

	Week. Tons.	Year. Tons.
Tyrone and Clearfield	27	261
Alleghany Region	12	53
West Penn. R.R.	596	12,639
Southwest Penn. R.R.	11,663	112,030
Gas Coal, Penn. R.R.	240	7,716
Pittsburgh Coal, Penn. R.R.	2,220	19,692

Receipts at Port Richmond, 1,500; shipments, 13,000 tons; and balance on hand 5,000 tons.

Receipts at Greenwich, Philadelphia:

	Bituminous.	Gas Coals.
Receipts	4,809	....
Shipments	4,944	258
On hand	86	....

The decrease of shipments of Cumberland coal over the Cumberland Branch, and Cumberland and Pennsylvania Railroads, amounts to 53,763 tons.

The receipts at Buffalo, via. L. S. & M. S. R.R. for the week were 5,016 tons.

The exports of coal from Baltimore for the week were 2,608 tons, and for the year, 11,609, as compared with 25,897 tons to the corresponding time in 1874.

	week.	year 1875.	year 1874.
The receipts of coal at Coal Port (Trenton)	..	..	16,800
" " " South Amboy	130	16,937	184,626
Shipments at Coal Port (Trenton)	..	..	15,008
" South Amboy	2,367	82,277	139,751

The demand for anthracite coal continues far ahead of the supply, stocks being almost entirely confined to the Pennsylvania Coal Company, the Delaware, Lackawanna and Western Railroad Company and the Delaware and Hudson Canal Company, who have orders several weeks ahead. We refer to another page of this issue for the position at the mines.

The Delaware and Hudson Canal Company announce that their canal will be opened on the 12th inst. Their shipments of coal last week were a little over the corresponding week of last year, while the Delaware, Lackawana and Western R. R. Co. show an increase of 25,886 tons. The total production of anthracite coal, since January 1, shows a decrease of 1,344,036 tons as compared with last year.

Our latest information from the coal regions is that the men are quiet; that a large fire is raging in the Stockton mines, which will be very serious if not soon checked, as it will cut off a number of mines; that the miners of the Lackawanna region will hold a public meeting at Hyde Park to-night, to take a definite vote on the question of striking for an advance of wages.

Special to the Engineering and Mining Journal.

SCRANTON—Friday Night.

The Scranton men have voted, by large majority, *not to stop work*. There is now every prospect of the Wilkes-Barre men going to work within a week on the reduction, and the other regions will doubtless soon follow.

The strike appears to be about ended.

There has been considerable Cumberland coal sold to parties who have heretofore consumed anthracite. Although, as yet, the contracts are not large, the aggregate is considerable. The great movement of the week was an attempt to form a combination among the producers in this interest, but nothing definite has yet been accomplished. The movement has the appearance of having been, to a great extent, brought about by an anthracite influence, although several of the companies favor the project if it can be placed upon a practical basis. The great fear is that the transportation companies will step in and increase the rates of freight to such an extent that the mining companies will be left no greater profits than they are now receiving, while with the anthracite companies, transportation and mining are under one control. However, the movement has been made, and there should be some plan by which prices of coal can be regulated so as to pay both transporters and miners. There is no doubt but that the price of Cumberland coal is unnecessarily low, especially in many markets. There were present at the meeting representatives of the Consolidation Coal Company, Borden Mining Company, Maryland Coal Company, New Central Coal Company, and Hampshire and Baltimore Company. They passed, unanimously, the following resolutions:

"*Resolved*, That it is advisable that some combination be secured among the Cumberland producing companies, similar to that now existing among the anthracite interest, in order that uniform and remunerative prices for coal may be secured.

"*Resolved*, That a committee of five be appointed by the Chair, from the companies represented at this meeting, with power to invite a representation of all other companies in the Cumberland field to coöperate in considering the resolutions herewith annexed, and to report to a general meeting of the companies the result of their deliberations."

The rules governing the Anthracite Association were placed before the meeting, and fully explained by a gentleman identified largely with that interest. Although a combination established on a firm basis might be of some advantage to the anthracite interest, yet it would be of much greater advantage to the Cumberland companies. We do not believe that the Cumberland companies will be able to send to market more than 500,000 tons additional to their shipments of last year, and from the present appearance of the position at the anthracite mines, they should be able to sell that quantity at full prices, and establish a demand that would be ahead of the supplies. At the present time, the production is about 50,000 tons behind last year. Cumberland is the best steam coal produced in the world, and the coal field is but a very limited one. With these facts in view, it looks like folly to mine the coal at a loss, or but a very small profit. A personal acquaintance with the officers of the Cumberland companies would lead us to suggest that the only practical plan, and one most likely to maintain a combination, would be to "pool" the whole production. The withdrawal of a large number of ocean steamers will very much reduce the usual consumption of this coal. We are reported the following sales: 20,000 tons to the Eastern Railroad; 15,000 to the Boston, Lowell and Nashua Railroad, and a number of small contracts.

Coastwise freights are lower, with a declining tendency, about $1 75 being paid from this city to Boston. From Baltimore to Boston, vessels are freely offered at $2 for single trips; to the Sound ports at $1 75, and to this city at $1 60. Georgetown rates ruling about the same as from Baltimore. Shippers are only offering $1 80 from Baltimore to Boston for season shipments.

The Board of Public Works held a meeting at Annapolis, Md., to receive a committee from Cumberland, who asked for a revision of the rates of toll on the Chesapeake and Ohio Canal. Mr. GORMAN, President of the Canal Company, proposed to reduce the rates of toll in connection with the Cumberland wharfage (now 51c.) 9 cents, and the Georgetown wharfage (now 33c.) 4 cents. The Board adjourned without taking definite action.

Wholesale Prices of Bituminous Coal.

The following prices are principally fixed for the season, except where otherwise indicated.

Domestic Gas Coals.

Per ton of 2240 lb.	At the Shipping Ports.	Alongside in New York.
Westmoreland and Penn, at Greenwich, Philadelphia	$5 20	$6 50
" " at S. Amboy	6 00	6 50
Red Bank Cannel Pa., at Phil.	8 00	8 50
" " at S. Amboy	8 50	....
" Orrel, "	6 00	6 50
Youghiogheny, Waverly Co, at Baltimore	5 25	6 50
Despard, West Va., nominal	" 5 00	6 60
Murphy Run, W. Va. at Baltimore, nom.	5 00	6 60
Fairmount, W. Va " nominal	5 00	6 60
Newburgh Orrel, Md. " "	5 00	6 00
Canneiton Cannel, W. Va., at Richmond.	9 50	11 00
" Splint, " " "	5 00	6 50
Peytona Cannel, " " "	9 50	11 50
Straitsville, " At Sandusky, O "	3 65	11 60

Foreign Gas Coals.

	Sterling.	Am. cur'cy.
Newcastle, at Newcastle-on-Tyne	10/6@12/9	6 50@ 7 00
Liverpool House Orrel, at Liverpool	26/	13 00
Ince Hall Cannel "	47/	18 00@20 00
" Gas Cannel "	30/	12 00
Scotch Gas Cannel, at Glasgow, nominal.	25/ Gold.	7 50
Block House, at Cow Bay, N.S.	2 00	5 50
Caledonia, at Port Caledonia	1 75	5 25
Glace Bay, at Glace Bay	380	5 50
Lingan, at Lingan Bay	75	....
Sydney, International and Reserve mines, at Sydney	2 00	5 50
Pictou, Albion and Vale mines, at Pictou	2 25	5 75

Steam and House Coals.

Broad Top, at the mine, $1,25; at Amboy	4 75@5 00	5 25@5 50
Cumberland, at Georgetown and Alexandria, Va.	4 20@4 25	....@....
Cumberland at Baltimore	4 40@4 50	5 75@6 25
Clearfield, "Derby," "Kittanning," "Sterling," and "Eureka," at the mines, $1.25; at Greenwich, Phil.	4 60	5 65
James River, carbonite, at Richmond, Va	6 75	9 00
" bituminous, " nom.	4 00	6 25

Retail Prices in New York.

Anthracite.

Per 2000 lb.	Grate and Egg.	Stove.	Chestnut.
Pittston coal, in yard	$6 00	$6 20	$5 40
Lackawanna Coal, del'd	7 60	7 85	7 10
*Wilkes-Barre, delivered	7 60	7 85	7 10
Lehigh & Locust Mountain, del'd	8 00	8 00	7 50
Schuylkill Red Ash del'd	8 25		

The cost of delivering Pittston coal ranges from 40 cents to $1 per ton, according to distance from the yard.

* Twenty-five cents less than the above rates are charged to manufacturers.

Bituminous.

Liverpool House Orrel, delivered, per ton of 2000 lb.	$23 00
Liverpool House Cannel " " "	25 00
American Cannel " " "	16 00
American Orrel " " "	$15 00@16 00
Straitsville Cannel " " "	15 00@16 00
Carbonite " " "	12 00
Cumberland " " "	9 00
Acadia, Pictou, N. S. " " "	14

Wholesale Prices of Anthracite Coal f.o.b., at the Tide Water Shipping Ports per ton of 2240 lb.

The prices of the Lackawanna, Scranton and Pittston Companies, in the following table, are all that have been fixed as yet for the month of April.

	Lump.	Steamer.	Grate.	Egg.	Stove.	Chestnut.
Wyoming Coals.						
†Lackawanna and Scranton at Elizabethport & Hoboken	4 60	4 70	4 80	4 95	5 40	4 40
Pittston at Weehawken	4 60	4 60	4 70	4 80	5 30	4 35
Wilkesbarre at Port Johnston	....	....	....	....	....	....
Plymouth, R. A.	....	..	....	....	....	....
Susque. Coal Co. at Amboy W.A.	....	....	....	....	....	....
Kingston at Hoboken	....	....	....	....	....	....
Lehigh Coals.						
Old Company at Port Johnston	....	....	....	....	....	....
Old Company's Room Run "	....	....	....	....	....	....
Sugar Loaf at "	....	....	....	....	....	....
Lehigh Coal Exchange "	....	....	....	....	....	....
Honey Brook at Elizabethport	....	....	....	....	....	....
Spring Mt. C. Co. at Hoboken	....	....	....	....	....	....
Beaver Meadow at South Amboy	....	....	....	....	....	....
Schuylkill Coals.						
Schuylkill white ash	....	....	....	....	....	....
Schuylkill red ash	....	....	....	....	....	....
Shamokin white and red ash	....	....	....	....	....	...
N. Franklin	....	....	....	....	....	....
Lorberry	....	....	....	....	....	....
Lykens Valley	....	....	....	....	....	....

Pittston coal is delivered to carts in New York or Brooklyn at 65 cents per ton in addition to the above rates.

	Per ton.
Freight from Hoboken and Weehawken to New York	45c.
" " Elizabethport & Port Johnston to New York	45c.
" " South Amboy to New York	50c.

Freight from Rondout to New York, by boats or barges of the D. & H. Canal Co., 50c. per ton.

We note the removal of Messrs. WALLACE & Co. from Doane street, where they were located for twenty-five years, to 40 Water street, Boston.

Philadelphia Coal Trade.

PHILADELPHIA, April 8, 1875.

Shipments of anthracite from this port continue to be confined to the Lykens Valley and Shamokin coals from the Greenwich piers of the Pennsylvania Railroad. Freights rule at $2 for Boston, and $1 75 to Providence. For a couple of days past, some Shamokin coal is coming again down the Reading Road.

The interest in coal matters appears to be concentrated on the reported troubles in the coal region, mostly in the Lehigh, every other place being quiet, according to the last accounts. The First Regiment of National Guards of this city is now at Hazleton. Matters seem to be near reaching a climax, and it is to be hoped that it will be a peaceful one.

The miners in the Clearfield bituminous region have asked an advance of 10 cents per ton for mining, which the operators decline to give, and it is generally expected amongst them that there will be a strike to-morrow.

The scarcity of coal is borne more patiently since the

weather has moderated, amongst the small consumers; manufacturers experience great difficulties in getting supplies, and numerous factories are stopped.

Baltimore, Md. April 6, 1875.

Reported by our Special Correspondent.

WHOLESALE PRICES PER 2240 lb.

ANTHRACITE.

	By cargoes.	In cars.
Wilkes-Barre, "Lee," or "Diamond,"		
Lump, steamboat	$5 15	$5 60
Broken	5 50	5 75
Egg	5 87	6 15
Stove	6 07	6 35
Pittston and Plymouth.		
Lump and steamboat	....	5 50
Broken	....	5 70
Egg	....	6 05
Stove	....	6 25
"Boston," freeburning white ash	....	5 50
Egg	5 87	5 70
Stove	6 07	6 05
Shamokin, (red or white ash)	....	6 25
Egg	5 82	6 05
Stove	5 92	6 15
Lykens Valley, red ash, egg and stove	6 02	6 55

From wharf or yard, wholesale, 50@75c. additional. By retail, all kinds and sizes, per 2,240 lb, $7@8 25.

BITUMINOUS.

George's Creek and Cumberland f. o. b. at Locust Point for cargoes	4 60	4 75
West Va. Gas Coal f. o. b. at Locust Point	5 50	....
Kanawha Cannel, coarse	x3 oc	....
Tyrone	7 25	....
Ritchie Mineral of West Virginia	1 00	....

Boston. April 6, 1875.

Reported by our special correspondent.

CARGO PRICES TO TRADE.

Lingan coal	$ 5 75	Westmoreland, and Penn.	7 25
Caledonia	5 00	Waverly Co. Youghiogh'y	7 25
Pictou	6 15	Cannelton Cannel	11 75
Block House	5 60	Cumberland	6 25@ 6 50
Red Bank Cannel	10 00	Anthracite,	6 50@ 7 25
Glace Bay	5 00	" Retail	7 50@ 8 00
Sydney	7 00		

The *Commercial Bulletin* of April 3rd says: "The market has been quite active at times, and holders continue firm in their views. There have been large sales of gas and Cumberland coal on private terms. The receipts for the week have been 11,225 tons domestic, against 8041 tons for the corresponding week last year."

Buffalo, N. Y. April 6, 1875.

Prices remain unchanged.

Chicago, Ill. April 6, 1875.

Specially reported by Messrs. RENO & LITTLE, Coal Merchants.

No change in prices of Anthracite

Retail prices per ton of 2000 lb. delivered to buyer.

		BITUMINOUS.	
Lehigh Lump	$10 75	Briar Hill and Erie	7 50@ ....
Lehigh prepared and car load lots	10 25	Walnut Hill (W. Va.)	6 50@ ....
Zackawanna, Wilkes-Barre and Pittston,*	10 00	Midway (West Va.)	6 50@ ....
Grate, egg, and chestnut.	10 00	Cannel	8 00@ 9 00
Stove or range	10 00	Blossburg	8 00
		Indiana Block	6 00
		Hocking "Brooks"	6 00
		Wilmington and Illinois	5 00

*75 cents off these prices for car load lots to country dealers and manufacturers.

Cincinnati, O. April 6, 1875.

Prices remain unchanged.

Cleveland, O. April 6, 1875.

Prices remain unchanged.

Detroit, Mich. April 6, 1875.

Specially reported by Messrs. ROBINSON & KEYS, dealers in all kinds of coal.

Please continue quotations as last reported. Trade is quiet.

Per ton of 2000 lb.

Lehigh Lump, per ton	$10 50	Blossburg	8 50
Lehigh " prep.sizes.	10 00	Briar Hill	7 50
Wilkes-Barre, Grate and Egg	9 00	Willow Bank	7 00
Wilkes-Barre, Stove and Nut	9 50	Erie	7 50
		Massillon	7 00

Erie, Pa. April 6, 1875

Reported by our Special Correspondent.

Wholesale, per ton of 2,000 lb.

Bituminous f.o.b.

Briar Hill lump	$4 00
Beaver lump	$4 00

Indianapolis, Ind. April 5, 1875.

Prices remain unchanged.

Louisville, Ky. April 6, 1875.

Specially reported by Messrs. BYRNE & SPEED.

Please report our market the same as last with tendency to lower prices, and a more limited demand.

Pittsburgh, per load of 1900 lb	$3 50
Pine Hill	3 00
Buckeye Cannel	5 00
Peytona Cannel	5 50
Nut and Slack	2 25
Pine Hill nut	2 25
Kentucky lump, per load	....
" nut, "	....
" Slack "	....
City-made Coke, per bushel	....
Pittsburgh, wholesale, per bush	....
Kentucky on cars at wholesale, per bush.	....
Anthracite, per ton	$10 to $10 50

New Orleans, La. April 3, 1875.

Mr. C. A. MILTENBERGER says: the number of boats on hand April 1st were 128, and barges 2. The consumption during March was 16 boats, 11 barges, and 1 hull; the arrivals 38 boats and 7 barges. Rates to steam boats have declined 100. per bbl. since last report, owing to the limited demand and the low rates of wood. Holders of coal by the boat-load are inclined to withhold their coal from market until prices improve, 35c. per bbl. being below the actual cost. A very limited amount is on the market at that figure.

Pittsburgh coal, retail, per bbl	75c.
" wholesale	35c.
" to steamboats, per box	50c.
" to manufacturers, per bbl	60c.
" shipments per hhd	$7 00
Anthracite, retail, per ton	$12 00@13 00
" wholesale per ton	8 00
Spadra (Arkansas) coal, retail, per bbl	75c.
Mt. Carbon, wholesale, per bbl	45c.
" " retail per bbl	65c.
Virginia Cannel, per bbl	90c.
Scotch Cannel, per bbl	1 00

Pittsburgh, Pa. April 6, 1875.

Reported by our Special Correspondent.

Per ton of 2000 lb. and Bushel of 76 lb.

	per ton.		per ton
Youghiogheny coal	$2 00	Pittsburgh retail delivered per bushel	9c@10c
" coke	2 00@2 25	Anth'cite on cars Lehigh	$7 75
Connellsville coal	2 10	" " Wilkes-Barre	6 75
" coke	$2 25@2 50		
Pittsburgh coal	1 85		

Twenty-five to fifty cents per ton additional for delivery.

The Pittsburgh *Commercial* reports additional departures for Cincinnati of 297,000 bushels, and for Louisville of 982,000 bushels; other boats are to follow.

San Francisco.

From the *Commercial Herald*, March 25, 1875.

Imports from January 1st to March 16th, 1875:

Anthracite, tons	3,047	English, tons	19,358
Australian, tons	18,489	Vancouver Island, tons	14,080
Coos Bay, tons	6,518	Rocky Mountain, tons	24
Cumberland, tons	1,637	Seattle, tons	6,633
Mt. Diablo, tons (2 mos).	28,525	Bellingham Bay, tons	1,840

The wind-bound Coos Bay fleet is now arriving. The *Empire* and *Eastport* brought us 771 tons, and others near at hand. Price, ex ship, $10. The *Stella Maria*, from Newcastle, N. S. W., brought 870 tons; the *Celestial Empire*, from New York, 233 tons. There is no Cumberland in first hands, all here held by the dealers. The California Mt. Diablo supply is liberal; and this, with other coast mines now being developed, promises a large increase ere long. Black Diamond and other Mt. Diablo Coal is exclusively used for steam purposes by factories and inland steamers. The coarse commands $8 25 and the screenings $6 25 per ton—the latter preferred by many of our mills on the score of economy. The market is well stocked with all descriptions. We quote Coos Bay at $10; Wellington, $11@12; Australian, by the cargo, $9 75@10; Bellingham Bay, $8 50.

Halifax, N. S. April 5, 1875.

Reported by our Special Correspondent.

Prices per ton of 2240 lb. in gold.

Sydney (old mines)	$4 50	Little Glace Bay	3 50
Gowrie	3 50	Blockhouse	4 00
Victoria	3 50	Albion (at Railroad)	4 25

Montreal. April 6, 1875.

Specially reported by Messrs. ROBERT ADAMS & Co.

Wholesale per ton of 2,240 lb.

Scotch Steam	$6 25	Cape Breton Steam	$5 75
Pictou "	6 00	Newcastle Smiths	....

Anthracite at retail, 2,000 lb., delivered, less 5 per cent.

Egg	$8 50	Chestnut	9 00
Stove	9 50		

Toronto, Ont. April 5, 1875.

Reported by our Special Correspondent.

No change of prices since last report. Stocks will be all sold. There will be no Spring receipts of coal until opening of navigation, which will be about the 1st of May, a month later than last Spring—owing to severe cold and great thickness (3 feet) of ice in the harbors—which is yet quite solid.

ANTHRACITE.

	per ton.		per ton.
Broken	$7 65	Chestnut	$7 65
Egg	7 65	Lehigh	9 00
Stove	8 15		

BITUMINOUS.

Blossburgh	7 50	Screenings	5 00
Briar Hill	7 00	Soft Nut	5 50

Freights on Bituminous Coals from the Mines to Tide-Water Shipping Ports.

From the Mines to Cumberland and State Line (say an average of 20 miles) the charge is 3 cents per ton of 2240 lb. per mile.

From State Line to Amboy (346 miles) $3 75 per ton of 2000 lb. On coal shipped beyond this point there is a drawback of 50 cents per net ton.

From Cumberland to Baltimore, (178 miles) $2 31 per ton of 2240 lb., or $2 02 per net ton, and 4 cents per gross ton for use of cars.

From Cumberland to Georgetown, (152 miles) by canal. The Canal is open but shipments for the season as yet have not aggregated over 1,000 tons; rates not known.

From the Mines to Piedmont, (from 4 to 10 miles) 5 cents per ton of 2240 lb per mile on distances less than 5 miles, and 4 cents per ton per mile on distances not over 10 miles.

From Piedmont to Baltimore, (206 miles) $2 69 per ton of 2240 lb., or $2 40 per net ton.

From any point in the Kanawha Valley to the James River wharves below Richmond, (say 350 miles) by C. and O. R. R., including terminal charges, per ton of 2240 lb or Cannel coal, $4 50.

Do., do., for Semi-Cannel or Splint, per ton of 2240 lb., subject to rebate on shipments of 5000 tons or more, $3 65.

From Irwin to W. Phila. (say 332 miles) per P. R. R. Penn.

Westmoreland gas coal, per ton of 2000 lb. $4 75

From Osceola to W. Phila. (say 248 miles) per T. & C. R. R., per ton bituminous coal of 2000 lb. 3 30

From Fairmount and Clarksburg to Baltimore (say 300 miles) via B. & O. R. R., including loading, per 2000 lb. 4 75

On through coal after deducting drawback. ....

From Richmond, Va., to New York, 392 miles per 2240 lb. 1 75

" " " *Boston*, about 650 " " 2 25

" " " *Philadelphia*, 292 " " 1 25

From the Mines to Richmond, via James River and Kanawha Canal, 15 miles. 15

Rates of Transportation on Anthracite Coal to Tide Ports.

Lehigh and Wyoming Coals. per ton of 2240 lb.	From Penn Haven.	From Mauch Chunk.	From Hazleton.*	From Upper Lehigh.	From Ashley and Sugar Notch.
To ‡ Newark, N. J. via Central Railroad of New Jersey	2 89	2 73	2 86	3 24	3 45
‡ Mauch Chunk, Pa. via Central Railroad of N. J.	16	..	56	51	72
‡ Phillipsburg, N. J.	1 09	93	1 34	1 44	1 65
‡ Elizabethport, Port Johnston, Hoboken and South Amboy, N. J. shipping and wharfage 35c. add.	2 47	2 31	2 80	2 82	3 03
High Bridge, N. J.	2 40	2 20	2 80	2 79	3 09
Somerville and Raritan, N. J.	2 80	2 60	3 20	3 19	3 49
Elizabeth, Cranford, Westfield and Elizabethport, for consumption.	2 95	2 75	3 35	3 34	3 64
¶ Jersey City, N. J., and New York, via Morris Canal	2 85	2 35	3 17	3 24	3 54
Andover, via Delaware, Lack. and and Western RR.	3 30	3 10	3 70	3 69	3 99
§ Trenton, Somerset Junction and Greensburg, via P. RR. Belvidere Division	2 65	2 45	3 05	3 04	3 34
Trenton, for shipment, including shipping and wharfage	2 11	1 95	2 45	2 46	2 76

* Rates on line coal from Hazleton are 10c. per ton above these figures.

‡ The cost of unloading is to be added to these rates. No charge less than 40c. per ton will be made for any distance. Tolls from Mauch Chunk to Phillipsburg for way points will be $1 15 per ton.

§ Twenty cents per ton less when five cars at a time to one party. Provided that where the reduction makes the rate $1 a ton, or less, the rate will be $1.

¶ 20 cents per ton additional for transferring coal from boat to boat, and 30 cents per ton for reshipment of same from wharves.

The following rates of freights and tolls on Schuylkill coals are to take effect from and after March 1, 1875:

Schuylkill Coals. per ton of 2240 lb.	From Pine Grove.	From Tamaqua.	From Port Carbon.	From Mount Carbon.	From Schuylkill Haven.
To * *Port Richmond*, for shipment, via P. & R. R. R., Main Line	1 87	1 82	1 75	1 74	1 67
Philadelphia, Retail yards.	1 97	1 92	1 85	1 84	1 77
Harrisburg, via Lebanon Valley Branch	1 23	1 80	1 73	1 72	1 65
Allentown, via East Pennsylvania Branch	1 52	1 47	1 40	1 39	1 32
Lancaster, and Points on Lancaster Branch, via R. & C. R. R.	1 57	1 52	1 45	1 44	1 37
Dauphin, via Schuylkill and Susquehanna Branch	62	....	1 25 via Aub	1 24 urn.	1 17
Jonestown, via Lebanon and Tremont Branch	86	....	1 69	1 68	1 61
Lebanon, via Lebanon and Tremont Branch	90	....	1 88	1 87	1 80

* On and after March 1, 1875, a charge of fifteen cents per ton will be made for shipping anthracite coal at this point.

From *Tamanend* to *Catawissa*, via Catawissa and Williamsport Branch Railroad. 94

From *Tamanend* to *Williamsport*, via Catawissa and Williamsport Branch Railroad. 1 39

THE BRITISH COAL AND IRON TRADES.

March 20, 1875.

North of England.—There is a fair demand for gas and household coals, but for steam and manufacturing kinds orders are scarce. Mr. KETTLE, the Umpire in the Northumberland miners' wages question, has given his award, and decided in favor of a reduction of 10 per cent. on hard coal, instead of 16 per cent. asked by the owners, and 12½ per cent., instead of 20 per cent. asked, on soft coal. On the whole, the decision has given satisfaction. The men at the Monkwearmouth pit have stopped work in consequence of the masters positively delining to discharge twenty non-union men. No fears being entertained now of a strike, coke is easier, and can be purchased at 13/ 6d.@16/ 6d. at the ovens. Coals retain their former prices, and are quoted as follows: Best steam coal, 15/@16/; seconds, 12/@14/; small, 3/@6/; households, 14/@16/. The iron trade is not in a very satisfactory condition; consumers will not buy beyond immediate requirements, and makers are not prepared to deliver promptly. In manufactured iron the situation is worse than with the furnaces. Many of the iron works are kept in operation at a loss, and about one-third of the puddling power of the district is standing idle. The questions of the wages of the Durham pitmen and the Cleveland iron-stone miners have been referred to arbitration, and it is anticipated that the decisions will be abided by. If substantial awards are made, they will have a tendency to improve trade by permitting the makers to re-

duce the cost of their wares. No. 1 pig iron is quoted at 63/; No. 2, 62/ 6d.; No. 3, 59/; No. 4 forge, 56/. Rails, £7@£7 15/.

Barrow-in-Furness.—Consumers are only buying iron for immediate wants, delaying their orders as much as possible, with the hopes of receiving lower quotations. There are, however, pretty large inquiries. The unsettled state of the coal trade in the region from which the district draws its supply interferes with the desires of the makers of iron to reduce prices. During the past month, a decline of 2/ 6d. per ton has been established on all descriptions of iron, making the quotations at present as follows: No. 1 Bessemer, £4 10/; No. 2, £4 7/ 6d.; No. 3, £4 5/.

Yorkshire and Derbyshire.—It is reported that some Leeds firms are obtaining iron from Belgium. The coal trade of that district is very quiet. At Sheffield, some branches of trade are beginning to look up, and workmen are more fully employed than at the first of the year. The Bessemer establishments are becoming more active, not only in rails, but in forgings also. There is a decided improvement in springs and crucible steel goods. The demand for cutlery, on American account, is slightly better than it has been. Ordinary rails and railway material continue quiet. There is every indication of a busy season for the makers of malleable goods.

Lancashire and Cheshire.—In the Manchester district, the demand for house coals is in excess of supplies. There is a good inquiry for furnace coal, and an increasing demand for slack. There is a much better demand for gas coals than is usually expected at this season of the year. Ordinary cannel, at the pits, is quoted at 22/ per ton; screened gas coal at 13/@14/; unscreened, 10/@11/. There is a good local demand for coke. The settlement of the labor questions in the North of England has, however, decreased the demand from outside districts. In the Wigan district there is a demand for about all the coal that is being produced. Engine coal and slack, however, are dull, and, although there is no great increase in stocks, prices are weaker. Prices are as follows at the pit mouth: Best coal, 12/ 6d.@14/; steam coal, 10/ 6d.@11/; burgie, 7/@8/; and slack, 4/ 6d.@6/ per ton, according to quality. In the Liverpool market there is a fair local demand for coal, but supplies are increasing, and prices are easier. Best coal is 17/ 6d.@18/ at the High Level or Garston, while commoner qualities have fallen from 14/ to 11/ without stimulating the demand. Makers of iron are fairly supplied with orders, especially for forge. The present prices are considered unremunerative and makers are not anxious to increase their production. Middlesbrough foundry, delivered in this district, is quoted at 67/ 6d. @68/ 6d., and forge at 64/@65/.

Wolverhampton.—The existing scale of wages does not, according to agreement, terminate until the end of June, and until a reduction can be made, no improvement is looked for, as the cost of production is so high that makers cannot offer sufficient inducements to buyers. The business doing is very small, but prices are maintained. In some few cases blast furnaces are being damped down. Common cinder pig is quoted from £3@£3 5/; mixed mine and flue cinder, at £4@£5; and Shropshire cold blast £6 10/ per ton. With the exception of the sheet and plate departments, the finished iron trade is very dull. The prices of marked iron are maintained on the basis of £10 10/, £11 and £11 12/ 6d. per ton, respectively, for the three leading brands. Common (unmarked) iron is freely offered at £8 15/, and some few transactions are reported at £8 10/ per ton. The demand for coal is quiet, but for best qualities satisfactory prices are being obtained. The collieries throughout the district are, as a rule, only in partial operation. Earl DUDLEY is obtaining for his best thick coal, 18/; seconds, 13/; and lumps, 12/ per ton. Heather coal (large) is quoted at 18/; lumps, 12/; and screenings, 13/. Common furnace coal is selling on the Wolverhampton side of the district at 11/ per ton.

Wales.—The strike and lock-out continue without any change. There is much suffering among the families of the miners, and many of the best classes of ironworkers are leaving the district, fearing that they will not be furnished with work for a long time. The non-associated companies are reaping a rich harvest, but in some qualities of coal they find concessions necessary to make sales. Double screened steam coal is quoted at 19/@20/ f. o. b. Cardiff; colliery screened, 18/@19/; small 6/ 6d.@7/ 6d; best patent fuel 19/. The iron trade is very quiet, with no encouraging prospects ahead. There are about 150 blast furnaces standing idle, in addition to the mills, etc. Some works taking advantage of the situation are doing quite an active business. The quotation for rails is about £6 15/, and it has been proved that a reduction must be made from this price that can hardly be brought about even by a 20 per cent. reduction of wages, instead of 10 per cent. as now asked by the masters. Hotblast foundry iron is quoted at £4@£4 10/; forge £3 15/; refined £4; cold-blast foundry £6; forge £6; and refined £5. Common bars are quoted at £9@£9 10/, and best bars at £10@£11.

Scotland.—On March 16, the price of warrants was 73/ 3d @ 73/ 6d. The quantity of pig iron in Connal's stores, on Monday afternoon, was 27,868 tons, being 950 less than at the same time last week. Within the past few days, the prices of the principal makers' brands have fallen from 1/ to 2/ 6d., the quotations being as follows:—Gartsherrie, No. 1, 87/ 6d.; No. 3, 77/; Coltness, 89/ and 76/; Summerlee, 87/ 6d. and 75/; Langloan, 86/ and 76/; Govan, 75/ and 73/; Calder, 87/ 6d and 75/; Shotts, 87/ 6d. and 77/; Carnbroe, 82/ and 74/; Monkland, 75/ and 73/; Clyde, 76/ and 74/; Glengarnock, 84/ and 75/; Eglinton, 75/ and 73/; Dalmellington, 74/ and 72/; Carron, 77/ 6d. and 75/; Kinneil, 80/ and 72/. The shipments of pig iron from Scotch ports during the week ending the 13th inst., amounted to 9670 tons, showing a decrease of 946 as compared with those of the corresponding week of 1874. The imports of Middlesborough pigs at Grangemouth for the week were, 3,610 tons, being 2,150 more than in the corresponding week of last year. The coal trade is in a very depressed condition, and prices have again been reduced about 6d. per ton. Household coals are selling at from 9/ to 14/; Wishaw Main, 8/ 6d. to 9/ 6d.; steam, 10/ to 12/; smithy, 15/ 6d.; splint, 9/ 3d. to 10/. A conference of miners' delegates was held in Glasgow, on Tuesday, at which was read a letter from Mr. MACDONALD, M.P., referring chiefly to the question of arbitration and to the South Wales lock-out. The miners of Fife and Clackmannan have received notice of a further reduction of 20 per cent. in their wages, to take effect in the course of a fortnight. The employers have been asked to meet the men in conference over the question, but no answer has yet been received.

IRON MARKET REVIEW.

New York.

April 9, 1875.

American Pig.—The market continues without any improvement. Sales are only being made in a small way, and rumors of prospects of a total cessation of coal mining have had no influence on prices. The outlook for business in the early future is not in the least encouraging. No. 1 Foundry is quoted at $28; No. 2, $26; and Forge, $24@26. The *Bulletin* of the Iron and Steel Association says, that out of 119 anthracite furnaces built, 56 are in blast and 63 out of blast. The following are using coke: The Thomas Iron Co., Crane Iron Co., SEYFORT MCMANUS & Co., E. & G. BROOKE, Montgomery Iron Co., Pennsylvania Steel Co., Chickies furnaces, Wistar furnace, and MCCORMICK & Co. The Thomas and Crane Companies are using with anthracite coal a mixture of about one-fourth coke. It has been proved by actual experiment in anthracite furnaces, that 1¼ tons of coke is equal in smelting power to 1¾ tons of anthracite coal.

Scotch Pig.—Under liberal arrivals, the market has been completely unsettled, and lots have been sold from steamer at less than cost of importing. We notice arrivals of about 400 tons of Eglinton; 400 tons of Coltness; and 100 tons of Glengarnock. Part of this quantity was sold before arrival. We are reported sales of Coltness at $34 50@$35 50, from ship. We quote Coltness at $36@38; Glengarnock, $36 50; and Eglinton, $33@$34. We suppose importations have been made in anticipation of the usual Spring demand, which has not made its appearance this season, and should the arrivals continue, we are likely to see even lower prices.

Rails.—There have been no transactions of note. There is some inquiry, which, it is thought, will terminate in business. We quote American iron rails, at mills, at $48@50, and steel at $72 50@$75.

Messrs. BIGELOW and JOHNSTON, in their circular, dated March 31, say:

"There have been several quite large contracts for American rails, both steel and iron, closed during the past month here and in the West at fair figures but on long time. The future appears brighter, and we trust ere long to see all our mills well employed. In foreign, the stock in this market has been concentrated in the hands of one or two parties, about one-half is already disposed of for Canada, the balance held at advanced figures."

Old Rails.—We note a sale of 150 tons at $30, time and interest.

Scrap Iron.—We quote a sale of 200 tons on private terms, and quote at $35@$36. The stock is reported as light.

Boston.

April 3, 1875.

The *Commercial Bulletin* says:

"*Pig* is still without inquiry or any encouraging disposition beyond the effect of the reports from the producing points. These stimulate holders to a fair degree of firmness on values, but make no impression on foundrymen, who still would lack the avenues for moving out castings did they start up their stacks. A number of our leading architects have been collecting estimates on iron fronts for new blocks to go up in the near-by cities and towns when the frost comes out of the ground; building materials and labor being now remarkably low and capital idle and cheap. It is not improbable something may be done in the architectural way in April to encourage pig iron makers. Prices here quote $32@33 for fancy brands. The primary markets still quote $27@28 for No. 1, $24@26 for No. 2 and Gray forge $24@27; this latter brand being still relatively high from its apparent scarcity. Scotch Pig has no business but quotes Eglinton $34@35; Glengarnock $37.

Bar is in better supply, the Buffalo makers having let down values a trifle and started up; our receipts have been wholy from that point, and cover about 800 tons landed and 1,000 to arrive. This has sorted up stocks, but has not depressed prices nor quickened nor slackened the demand. The business doing is still of a sort of a blacksmith, picayune nature. The current of sales is steady, but the single bills are very small. For refined $60 is the general asking price, with perhaps a little less disposition to shade, as dealers insist their margin now to land is not a dollar per ton, to which are to be added handling, storing, &c. In boiler plates a fair business is doing. We quote Bay State flange 5¾c., do. C. No. 1, 4¾; Pennsylvania flange 5½c., do. C. No. 1, 3¾c. In boiler pipes a small inquiry exists, the agreement on lap welded being maintained, quoting 2-inch 20c, and 3-inch 31c. net. Gas pipe is low and not very brisk, parties stating their ability to purchase at 5c. per pound, quality guaranteed at 2 lb. per foot.

Steel is moving along in a quiet, steady way, the small tool makers taking a little more interest. We quote American tool 15@15¼c.; American Machinery 9½@10c.; do. tires at 6½@7c.; English Tool, 16@17c.

Copper has had a trifling inquiry, but as yet no business. The business discussed is in futures on which values do not vary from 21¼@21¾. The same as governs spots. We quote New Sheathing 28c.; Bolts and Braziers 30c.; Yellow Metal Bolts 28c.

Lead—is very dull and easy, lots of domestic still offering from New York at 5¾c. Sheet and Pipe 9c. c'y; Tin-Lined Pipe 16¾c.; Bar Lead 9c., less usual trade or 10 per cent discount.

Spelter is easy at 6¼c. currency.

Tin is quiet and unchanged, possibly a little better feeling, but without any change to quotations, nor any inquiry seeking lots. We quote at 21¾@22c. gold for Straits. Refined English is unchanged for 21@21¾c. gold. Plates are active; we quote Charcoal I. C,, $10@12 50; Coke $8@10; and Terne at $8@ $12 50 per box, currency."

Cincinnati.

April 6, 1875.

Specially reported by Messrs. TRABER & AUBERY, commission merchants for the sale of pig iron, blooms, ore, etc.

The market for pig iron remains substantially as last reported. There is a fair demand for foundry and mill iron, with no change in prices. We quote:

CHARCOAL.			
Hanging Rock, No. 1, Foundry	$28 00@29 00	—4 mos	
" No. 2, "	27 00@28 00	—4 mos	
Mill	26 00@	—4 mos	
Tennesse No 1, Foundry	27 00@28 00	—4 mos	
Tennessee. No. 2 "	26 00@27 00	—4 mos	
" Mill	26 00@	—4 mos	
Missouri, No. 1, Foundry	30 00@32 00	—4 mos	
STONE COAL.			
Ohio No. 1, Foundry	27 00@28 00	—4 mos	
" No. 2, "	26 00@27 00	—4 mos	
Ohio Mill	25 00@26 00	—4 mos	
Missouri, No. 1, Foundry	28 00@29 00	—4 mos	
" No. 2, "	27 00@28 00	—4 mos	
" Mill	26 00@27 00	—4 mos	
CAR-WHEEL.			
Hanging Rock, C. B.	45 00@50 00	—4 mos	
Tennessee "	40 00@45 00	—4 mos	
Missouri "	40 00@45 00	—4 mos	
Alabama "	40 00@45 00	—4 mos	
BLOOMS.			
Charcoal	75 00@ 85 00	—cash	
SCRAP IRON.			
Cast	75@ 90	—cash	
Wrought	1 25@ 1 50	—cash	

Chicago.

April 6, 1875.

Prices remain unchanged.

Cleveland.

April 6, 1875.

Prices remain unchanged.

Indianapolis, Ind.

April 6, 1875.

Prices remain unchanged.

Louisville.

April 6, 1875.

Specially reported by Messrs. GEORGE H. HULL & Co.

The market is quiet, but without indications of any change in price.

The usual time, 4 months, is allowed on the quotations below.

HOT BLAST—CHARCOAL.	
No. 1 foundry, from Hanging Rock Ores	$28 00@29 00
No. 2 " " "	26 00@27 00
No. 1, Mill, from " "	25 00@ ....
No. 1, foundry, from Alabama, Georgia and Tennessee ores	26 00@27 00
No. 2, foundry, from Ala., Geo'a and Tenn. ores	25 00@26 00
No. 1, Mill, from " " " " "	25 00@ ....
HOT BLAST—STONE COAL AND COKE.	
No. 1, foundry, from Hanging Rock ores	27 00@28 00
No. 2, " " " " "	25 00@26 00
No. 1, Mill, " " " " "	24 00@25 00
No. 1, foundry, from Ala., Geo'a and Tenn. ores	26 00@27 00
No. 2, " " " " "	25 00@26 00
No. 1, Mill, " " " " "	24 00@25 00
No. 1 foundry, from Missouri ores	28 00@29 00
No. 2 foundry, from Missouri ores	27 00@28 00
No. 1 Mill, from Missouri ores	27 00@28 00
COLD BLAST—CHARCOAL.	
Car Wheel from Hanging Rock ores	40 00@50 00
" " Tennessee "	35 00@37 00
" " Alabama and Georgia ores	38 00@40 00
" " Kentucky ores	30 00@42 00

Pittsburgh.

April 3, 1875.

Specially reported by A. H. CHILDS, Esq., commission merchant, for the sale of pig iron, blooms, ore, etc.

Metal market is quiet, and quotations unchanged.

No. 1 foundry	$26 00@27 00	—4 mos
No. 2 foundry	24 50@25 00	—4 mos
Gray forge	24 00@	—4 mos
White and mottled	22 00@23 00	—4 mos

The *Pittsburgh Commercial* of April 3, says:

"We can note no change in the market for raw iron this week as the lock-out still continues. There is very little metal being used. The price remains about the same as at date of last report, and $24 00, four months, may be fairly quoted as the price for grey forge iron. There are still some sales of muck bar, and we hear of several lots that were offered at $44

and $45 per ton without finding purchasers. We are reported the following sales:

MUCK BAR.

500 tons muck bar, neutral.....$43 86—cash.
150 tons muck bar, neutral..... 44 oc—cash.
100 tons muck bar, neutral..... 44 oo—cash.
100 tons muck bar, neutral..... priv. terms.

BITUMINOUS COAL SMELTED FROM L. S. ORE.

200 tons gray forge..... $24 oo—4 mos.
80 tons gray forge..... 24 oo—4 mos
40 tons No. 2 foundry..... 25 50—4 mos.
30 tons No. 1 foundry..... 27 oo—4 mos.

ANTHRACITE.

20 tons No. 2 foundry.....$25 oo—cash.
10 tons No. 2 foundry..... 25 oo—cash.

CHARCOAL.

10 tons Lake Superior.....$33 oo—4 mos.
10 tons Eastern cold b'ast..... 38 oo—4 mos.

BLOOMS.

20 tons Missouri.....$78 oo—4 mos.

The *American Manufacturer* of April 7 says: "There is nothing new or significant to report in regard to pig iron. Business, so far as relates to mill irons, is well nigh suspended, and will continue so as long as the lock-out holds out. The mills will not buy until they have started up their puddling furnaces, as they have no use for it as long as the strike continues, and there is no inducement apparent just now to anticipate future wants; however, notwithstanding the present depressed condition of the market, there is, so far as we can learn, no disposition manifest to make concessions in order to effect sales. The producing interest generally feel confident in regard to the future, that there will be a brisk demand as soon as the lock-out is ended, and they are hopeful, in view of the fact that the stock of standard forge iron is not as large as was generally believed, and the production light, of being able to realize better prices."

San Francisco. March 25, 1875.

From the *Commercial Herald*.

Invoices of Scotch Pig Iron can be laid down here for summer delivery at $37 50@40 per ton. There is at present very little stock here in first hands, yet the foundries are carrying liberal supplies, and at the same time our consumption is large and steadily increasing. The spot price is $45@47 50. No Oregon here, owing to some accident at the furnaces causing a temporary suspension. The price here remains as heretofore unchanged, with a liberal local supply of bar, pig, sheet, and pipe lead. Banca Straits and Australian Block Tin is very plentiful, and although in some little demand, low prices prevail. Tin Plate is in large stock, but the demand is light at low prices. Yellow Sheathing and Sheathing Copper sell only semi-occasionally, and prices irregular and hard to quote. When an emergency arrives, supplies are sent overland upon orders. The wholesale trade in iron, steel, etc., is in few hands—monopolized by four or more wealthy firms who regulate prices to suit themselves.

METALS.

NEW YORK, April 9, 1875.

Gold Coin.—During the week past, gold has ranged from 114 to 115, and closed yesterday at 115.

Bullion.—Fine silver bar is quoted at $1 25¾@$1.26⅛; gold, per ounce, and fine gold bar, at par ($20 67, gold, per ounce) to ¼ per cent. premium.

Copper.—There has been more business during the week under review, but it has been almost entirely with dealers. Consumers have not yet entered the market for any large quantities. There is a rumor of a sale of 250 tons Lake Copper for export, but we were unable to authenticate it. On the 6th instant, 300,000 lb. were exported to Germany. There have been additional sales, amounting to about 300,000 lb. at 21¾c. @ 22c., the latter figure being bid now. Baltimore Copper is being quoted at 22½c.@23c. The latest cable quotations are £80 for Chili Bars, and £87 10/ for best selected. Messrs. JAMES and SHAKESPEARE, London, under date of March 25, say: "Chili *Bars* are neglected, and only a small business reported at £80 cash, and same price three months fixed for good *ordinary* brands; also a few tons of *Picked* marks at £80 15/ cash. This dulness has prevailed in spite of the charters for first half of present month being only 1,200 tons *Bars* and *Ingots*, 300 in *Ore* and *Regulus* for England; 200 tons *pure* going to the United States. This makes the fourth successive advice in which the quantity has been 1,800 tons and under. *Australian* remains dull, but without quotable change of price. *English* sorts are rather easy; within the last day or two, however, there was more enquiry both for home consumption and export."

Tin.—The market for pig tin has been very quiet. Prices remain without material change at 20¾c.@21c., gold, for Straits; Refined 20¾c.@20¾c.; L. & F., 19¾c.; Banca, 25c. Straits is quoted in London, by cable, at £86. By mail, bearing date of London, March 25, we receive the following:—"More firmness is apparent, in consequence of the continuance of large speculative purchases of Straits, both on the spot and for arrival. On Tuesday last values had risen fully 3/ per cwt. above those ruling on 19th inst., since when, however, the market has become rather quieter, and closed yesterday at a reduction of about 1/ per cwt. from the highest point. Australian is mostly kept back for higher prices, and the transactions in this sort have therefore been extremely limited."

Lead.—The sales of the week have been very limited not aggregating more than 100 tons of Domestic at 5¾c., gold. Soft Missouri can be laid down here at 6.80c., currency, equal to about 5.92, gold. Common Western can be laid down here at 6.70c. currency, equal to 5.83c. gold. Foreign is quoted nominally at 6¾c., gold. The shipments of bullion from the West are reported as having been light during March, said not to exceed 1000 tons.

Spelter and Zinc.—We note sales aggregating 50 tons of Domestic at 6¼c.@6¾c., currency. The market has become more firm and 7c.@7¼c., currency, is being asked now. The whole stock of foreign is reported as taken upon private terms.

Antimony.—Is in light stock and held at 12¼c.@12½c., gold.

Quicksilver.—The market is very unsettled, $1 per lb. being the nominal asking price in this city. Our latest London advices are under date of March 25, quoting nominally at £16 per flask, and saying: "The late fall has quite frightened buyers, who now refuse to operate until the future of this article is more defined."

The San Francisco *Commercial Herald* of March 25, says: "Exports for the past week embrace a shipment to Mexican ports, per steamer *City of Panama*, of 1,000 flasks. We are advised of small sales for New York upon private terms. 250 flasks sold for China at 85c. cash; 1,000 flasks sold for local use at 75c. for future delivery.

FINANCIAL.

New York Stocks.

April 7, 1875.

The New York Stock Market exhibits a marked improvement in quotations, with the volume of sales slightly below those reported for the week ending the 31st ult. The transactions in bonds show a slight increase in sales, with improved prices.

Quotations are as follows:

	Highest.	Lowest.	Closing.
Pennsylvania Coal Co.	—	—	—
Consolidation Coal Co.	47	46	47
Spring Mt. Coal Co.	—	—	70
American Coal Co.	—	—	—
Maryland Coal Co.	—	—	—
Cumberland Coal and Iron Co.	—	—	—
N. Y. & Nova Scotia Iron Co.	—	—	—
Del., Lack. & West. R.R. Co.	113	110⅝	112
New Jersey Central R. R. Co.	112⅝	110	112⅛
Delaware and Hudson Canal Co.	115	114	115
Quicksilver Mining Co. pref'd	33	32	32⅛
" " Common	26	24⅛	24⅜
Mariposa Land & Mining Co.	4	3¾	4
St. Louis & Iron Mountain R. R.	—	—	17
Wilkes-Barre Coal Co.	—	—	—

Sales for the week, ending April 7th, inclusive, were as follows:

	Shares.		Price.	
Del., Lack. and W. RR	3,442	at from	110⅛	to 113
Del. and Hudson Canal	351	"	114	" 115
New Jersey Central RR	817	"	110	" 112⅝
Quicksilver Mining Co.	1,300	"	24½	" 26
Consolidation Coal Co.	400	"	46	" 47
Mariposa Land & Mining Co.	1,000	"	3¾	" 4
Maryland Coal Co	...	"	..	" ....
St. Louis & Iron Mountain R. R	200	"	17	" ....
Spring Mountain Coal Co	200	"	70	" ....
Quicksilver Mining Co., pref'd	400	"	32	" 33
Pennsylvania Coal Co.	....	"	..	" ....
American Coal Co.	....	"	..	" ....
Total Sales	8,110	shares.		
Sales for the week previous	8,900	"		
Decrease	790	"		

The following are the sales of bonds for the same period:

	Amount.		Price.	
Del., Lack. & W. RR convertible,	$ 8,000	at from	112	to 114⅛
N. J. Central RR. 1st consolidated mortgage bonds	37,000	"	104¼	" 104¾
St. Louis & Iron Mount'n 1st Mtg bonds,	....	"	..	" ....
St. Louis & Iron Mountain, 2d Mtg. bonds	....	"	..	" ....
N. J. Central Convertible	5,000	"	110	" ....
" " 1st Mtg. N.	....	"	..	" ....
Del. & Hudson Canal, 1st Mtg. Reg. bonds, 1891	....	"	..	" ....
Del. & Hudson Canal, 1st Mtg Reg. bonds, 1891	....	"	..	" ....
Del. Lack. & W. R. R., 2d Mtg.	....	"	..	" ....
C. & O. R.R. 1st Mtg. Coupon	1,000	"	45	" ....
Total Sales	$51,000			

Philadelphia Stocks.

April 6, 1875.

The market for Philadelphia stocks has been generally steady during the week, with fluctuations scarcely worthy of note. Transactions have materially fallen off, as compared with our last. Both stocks and bonds closed firm.

The Pennsylvania Steel Company have announced a dividend of 3 per cent., payable April 5.

We note the following sales as having occurred at auction to-day:

39 shares Pennsylvania Steel Company, 71; 20 shares Cambria Iron Company, 17; 20 shares Emaus Iron Company, 35; 100 shares Bethlehem Iron Company, (par 100) 48½; $2,000 Charlestown Mining and Manufacturing Company First Mortgage Coupon Bonds, 102.

The coupons on the First Mortgage Bonds of the H. & B. T. R. R., due April 1, 1875, will be paid on and after that date, at the office of the Company.

Quotations are as follows:

	Lowest.	Highest.	Closing.
Reading R. R. Co.	55⅛	57	56⅜
Lehigh Valley R. R. Co.	62½	63	63
Little Schuylkill R. R.	—	—	49
Catawissa R.R.	20¼	21⅜	21¼
" " Preferred	—	—	43⅜
" " New Preferred	—	—	39
Huntingdon and B. T. R.R.	—	—	8⅜
" " " " Preferred.	15½	16	16
Minehill R.R.	53	53⅜	53
Lehigh Coal and Navigation Canal	50¾	51⅛	51
Morris Canal	—	—	51½
" Preferred	—	—	128½
Pennsylvania Canal	—	—	—
Schuylkill Navigation Canal	—	—	7⅜
" " Preferred	—	—	15
Susquehanna Canal	—	—	6¾
Westmoreland Coal Co.	—	—	86
Buck Mountain Coal Co.	—	—	40
Cambria Iron Co.	—	—	16
Locust Mountain Coal Co.	—	—	—
Emaus Iron Co.	—	—	35
Crane Iron Co.	—	—	55

The following are the aggregate sales of stocks for the week ending April 6:

	Shares.		Price.	
Reading Railroad	3,779	at from	55⅛	to 57
Lehigh Valley RR. Co.	521	"	62⅜	" 63
Little Schuylkill RR.	128	"	49	" —
Catawissa RR.	1,100	"	20¼	" 21⅜
" " preferred	20	"	43⅜	" —
" " new preferred	109	"	39	" —
Huntington & B. T. R. R.	200	"	8¼	" —
Huntington and B. T. RR., p'f'd	931	"	15⅜	" 16
Minehill RR.	44	"	53	" 53½
Lehigh Coal and Navigation Canal	6,468	"	50¾	" 51⅛
Schuylkill Navigation Canal	....	"	—	" —
" " " p'f'd	49	"	15	" —
Morris Canal, preferred	....	"	—	" —
usquehanna Coal Co.	....	"	—	" —
Cambria Iron Co.	....	"	—	" —
Pennsylvania Canal	....	"	—	" —
Susquehanna Canal	....	"	—	" —
Emaus Iron Co.	12	"	35	" —
Buck Mountain Coal Co	200	"	30	" —
Total sales	13,584	shares.		
Sales for the week previous	25,948	"		
Decrease	12,364	"		

Sales of the various bonds for the period under review have been as follows:

	Amount.		Price.	
Reading RR. 6s, 44, 80	$	at	..	to ....
Catawissa RR., new 7s	....	"	..	" ....
H. and B. T. RR., 2d mortgage, 7s	....	"	..	" ....
Lehigh convt. gold loan	1,000	"	104½	" ....
Pa. and N. Y. Canal, 7s	1,000	"	106	" ....
Schuyl. Nav. 6s, '82	7,000	"	80	" ....
L. V. RR. 6s, coup	2,000	"	103	" ....
H. and B. T. 1st Con. bonds	7,000	"	56½	" ....
R. C and I. Co. irregular mort. bonds, Hili Tract	....	"	..	" ....
Lehigh Nav. 6s, 1884	3,800	"	100⅜	" 100¼
Reading RR. debenture bonds	1,000	"	79	" ....
" " R. G. M. 7s, coup	....	"	..	" ....
" " new convertible 7s	500	"	106¼	" ....
Reading C. and I. Co. debenture bonds.	4,000	"	84⅜	" ....
Reading C. and I. Co. mort. bonds, Tamaqua Tract	7,000	"	90⅛	" ....
Reading C. and I. Co. mort. bonds, St. Clair Tract	....	"	..	" ....
R. C. & I. Co, Wetherill tract	....	"	..	" ....
" " " " Locust Mountain Summit Improvement tract	....	"	..	" ....
R. C. & I. Co. Helfenstim tract	....	"	..	" ....
Lehigh Valley RR. 6s, registered	....	"	..	" ....
" " 7s	1,000	"	108	" ....
Lehigh Coal & Nav. Co. 6s, gold loan	9,000	"	101⅛	" ....
" " " 6s, RR. loan	2,000	"	100⅜	" ....
Schuylkill Nav. 6s, '95	....	"	..	" ....
" " 7 per cent. boat loan	10,600	"	93	" ....
" " 6s, '72	550	"	94	" 95
" " Div'd scrip	600	"	94	" ....
R. C. & I. Co., Glentworth tract	....	"	..	" ....
Chesapeake & Delaware Canal, 6s	....	"	..	" ....
Susquehanna Canal, 6s	....	"	..	" ....
Pennsylvania Canal, 6s	....	"	..	" ....
Shamokin Valley & Pottsville R.R., 7s	....	"	..	" ....
Allegheny Valley 7 3-10s	....	"	..	" ....
" " " Eastern Exte'n	3,000	"	..	" ....
Del. Div. Canal, 6s	....	"	85	" ....
Total Sales	$50,456			

Gold and Silver Stocks.

SAN FRANCISCO, April 7, 1875.

A decided decline has transpired in the San Francisco stock list. Consolidated Virginia and Best and Belcher are the only exceptions to the downward movement of the list.

The Consolidated Virginia Mining Company is reported to have announced a dividend of $10 per share, (equal to $1,080,000,) for its earnings for March.

Quotations, April 7, 1875:

Gould & Curry	19	Raymond & Ely	42
Savage	125	Eureka G. V.	9
Chollar Potosi	63	Best & Belcher	50
Ophir	91	Kentuck	17
Hale and Norcross	43	Meadow Valley	7
Crown Point	37	Alpha	20
Yellow Jacket	83	Sierra Nevada	11
Belcher	36	Union Consolidated	8
Imperial	9	Mexican	27
Consolidated Virginia	455	Caledonia	18
California	62	Silver Hill	11
Overman	61		

Copper Stocks.

BOSTON, April 8, 1875.

Copper stocks are dull, and prices are nominally unchanged. The sales during to-days operations of the Board are comprised in slight transfers of Calumet and Hecla and Franklin at our quotations.

Quotations are as follows:

Allouez	7⅛	National	2⅛
Calumet and Hecla Co.	146	Phœnix	—
Copper Falls	8⅛	Quincy	35⅛
Central	24⅛	Ridge	6
Franklin	10	Rockland	—

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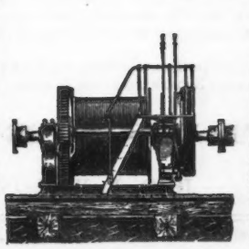

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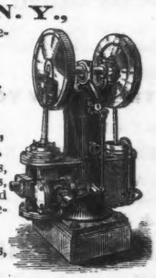

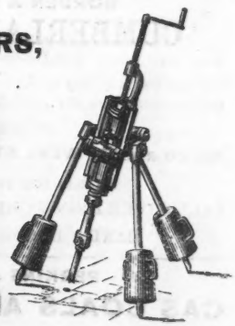

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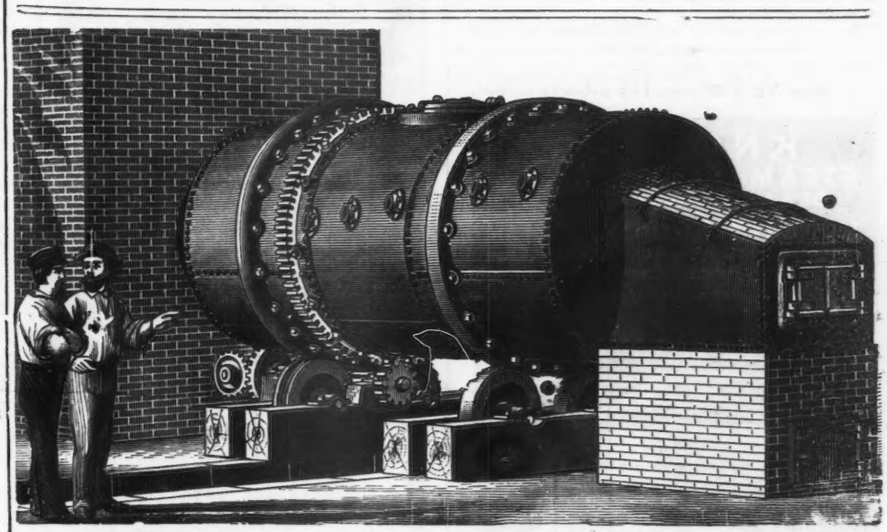

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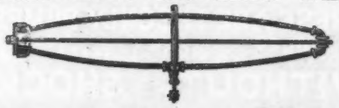

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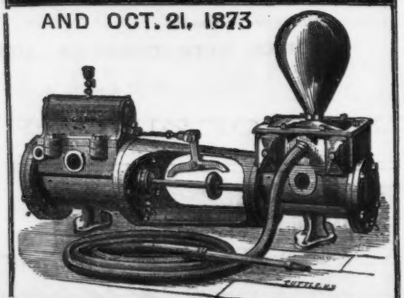

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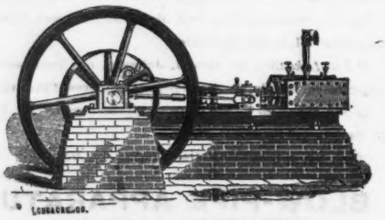

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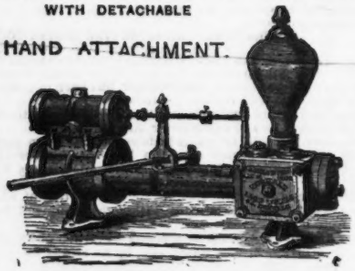

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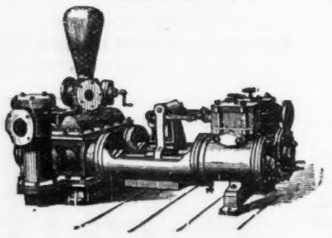

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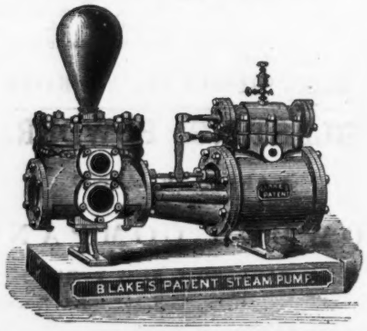

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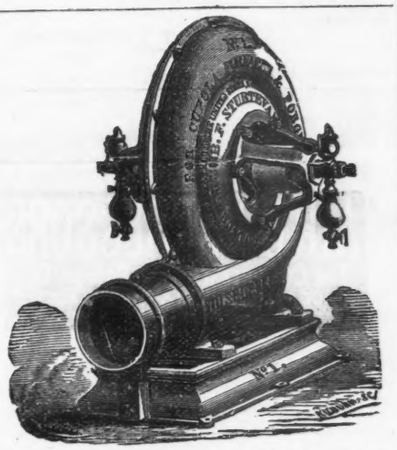

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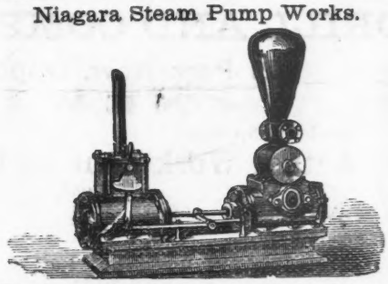

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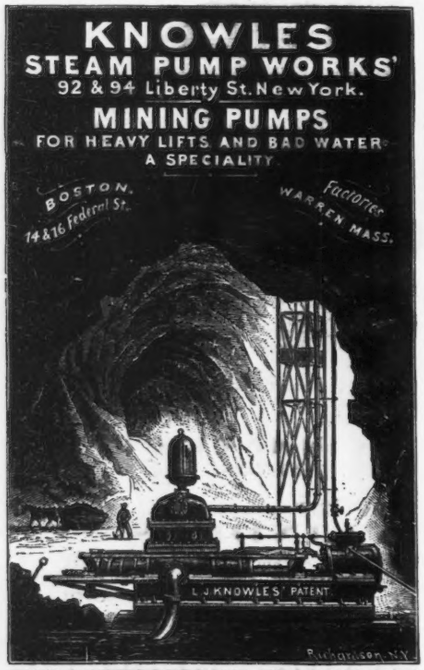

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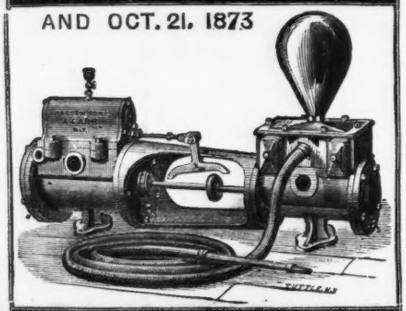

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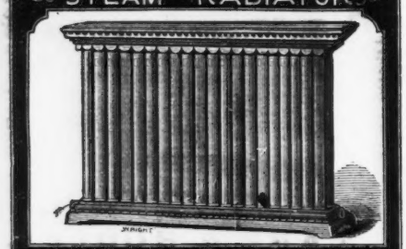

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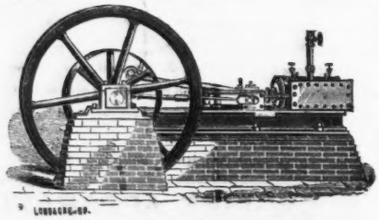

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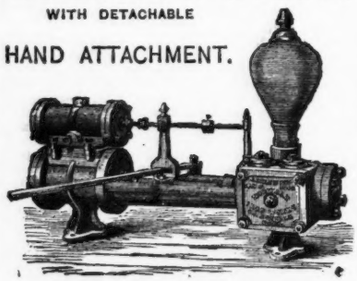

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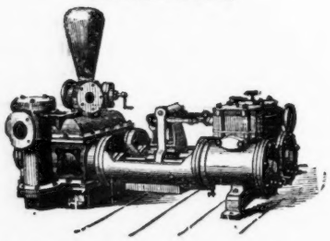

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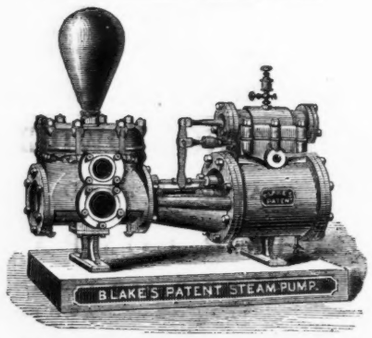

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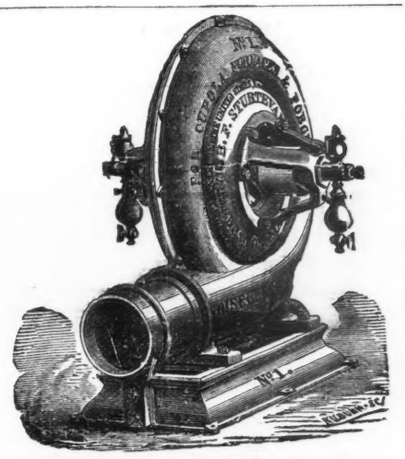

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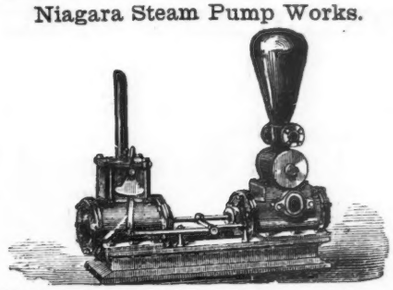

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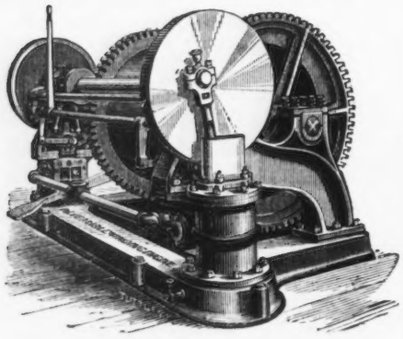

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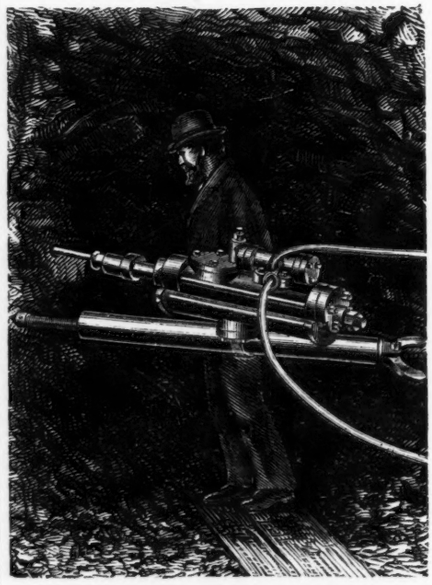

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(Signed.) WALTER TEFFT, Sup't.

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